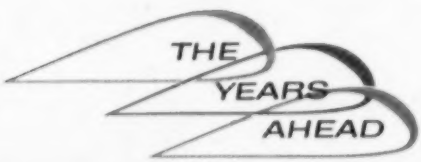
MODERN PLASTICS

June 1956

National Plastics Exposition New York, June 11-15, Commands World Attention

Program and list of exhibitors—Opp. Page 1



page 150 **Markets**
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To **AVOID CORROSION** *of sealed-in switch contacts*

Ultra-small precision switch
manufactured by Micro Switch Division,
Minneapolis-Honeywell Regulator Co.,
Freeport, Illinois

. . . take a closer look at **DUREZ 15528**

SPI 7th national Plastics exposition new york coliseum june 11-16, 1956

This versatile phenolic in the Durez family solves the problem of sealed-in contacts when you are designing and molding electrical equipment. Being ammonia-free, it is a safeguard of dependable performance and will not corrode silver or other metals and their alloys. Its electrical characteristics, strength, and molding properties have made it a standard for many applications in this field.

Durez 15528 is suitable for compression, transfer, and automatic preforming and molding. Its low gravity and fast cure offer advantages in low production cost and it meets the requirements of military specification Mil-P-14D, type CFG.

Where can you use it most profitably... for yourself and your customers? Very likely you have jobs in the works right now that Durez 15528 would make more salable or more serviceable, or both. Make sure you have specifications on this molding compound, with details on its performance. Write to us and ask for the current data sheet.

DUREZ®

Phenolic Plastics that fit the job

DUREZ PLASTICS DIVISION
HOOKER ELECTROCHEMICAL COMPANY
1206 WALCK ROAD, NORTH TONAWANDA, N. Y.

HOOKER CHEMICALS & PLASTICS

7th National Plastics Exposition

and 1956 S.P.I. Annual Conference

The 7th National Plastics Exposition to be held in the New Coliseum, New York, N. Y., June 11-15, will top all previous Plastics Shows both in number of exhibitors and in variety of displays. More than 225 exhibiting companies from all parts of the United States, as well as from England, West Germany, and Italy, will include material suppliers, molders, laminators, reinforced plastics producers, extruders, calenderers, processors, fabricators, machinery manufacturers, instrument manufacturers, research and testing services, etc.

The S.P.I. Annual Plastics Conference will run concurrently with the exposition. Sessions will be held at the Hotel Commodore and will cover the automotive, packaging, building, refrigeration, and air conditioning fields. Program is given in detail on the following page.

Supplement to MODERN PLASTICS – June 1956

S.P.I. Annual Conference program

Monday, June 11

8:30 A.M.—Registration, Ballroom Foyer.
10:00—Concurrent sessions

1: Cellular plastics session, East Ballroom.

Papers will be presented on the use of cellular plastics in transportation (subways, aircraft, automobiles, trains, ships).

2: Sheet forming session, West Ballroom.

Tuesday, June 12

9:30 A.M.—General introductory address:

"Plastics Shaping Tomorrow's Products." Keynote speakers will give short addresses on following subjects:

1: Automotive

2: Refrigeration and air conditioning

3: Packaging

4: Building materials

5: Communications

Wednesday, June 13

9:30 to 11:30 A.M.—Concurrent sessions

1: Automotive session, Grand Ballroom

a) "Trends in Automotive Styling"

b) "Plastics Automotive Components"

c) "Advances in Body Manufacturing Techniques"

2: Packaging session, East Ballroom

a) "New Developments in Flexible Packaging"

b) "New Developments in Rigid Packaging"

c) "A Review of Vacuum Formed Visual Packages"

d) "Status of F.D.A. Legislation"

3: Building materials session, West Ballroom

a) "Plastics Today in Buildings"

b) "Code Problems"

c) "Plastics Tomorrow in Buildings"

d) Presentation of S.P.I. House Competition Award

12:30 P.M.—Luncheon, S.P.I. Annual Meeting

1: Announcements of new officers

2: Society reports

3: FCC Report—"Status of FCC Proposed Changes in Rules and Regulations Covering the use of High-Frequency Heating Equipment"

6:30 P.M.—International Dinner, St. Moritz Hotel.

Thursday, June 14

9:30 to 11:30 A.M.—Concurrent sessions

1: Refrigeration and air conditioning session, Grand Ballroom

a) "Sheet Forming"

b) "Moldings"

c) "Insulation"

d) "Design Engineer"

2: Communications session, West Ballroom

a) "Extrusion"

b) "Encapsulation and Miniaturization"

c) "The IBM Molded Flush Circuit"

d) "The Future of Plastics in Radio and Television."

12:30 P.M.—Retail Buyers' Luncheon

Friday, June 15

9:30 to 11:30 A.M.—Management Business Symposium.

Principal topic of discussion will be: "Sound Costing Practice."

Floor plan and exhibitors at the 7th National

A. & S. Steel Rule Die Corp.
Booth 536. Exhibit: Heat-sealing dies for packaging, belts, handbags, wallets, etc.; loading fixtures.
Representatives: Walter Solmsen, Kurt Auerhann, Jerry Solmsen.

Abaco Industries Inc.
Booth 846. Exhibit: Adiabatic extruder; automatic cutoff machine; automatic winder.
Representatives: R. Decat, L. Lamar.

Accurate Steel Rule Die Manufacturers
Booth 849.

Acme Machinery & Mfg. Co., Inc.
Booth 6. Exhibit: Extruder; Acme portable granulator; oven; double-end powder mixer; injection machine.
Representatives: Frank Cutroni, S. James Cutroni.

Advance Solvents & Chemical Div., Carlisle Chemical Works, Inc.
Booth 402. Exhibit: Stabilizers; data sheets and technical information on organo-tin stabilizers; organo-metallics; non metallics; and epoxy stabilizers.
Representatives: Geo. W. Gregg, M. F. Antonovich, J. Hermann, Dr. Emery Parker, Leonard Nass, Daniel Rohling, John Da Silva.

Aisteele Engineering Works, Inc.
Booth 1209. Exhibit: Machinery for grinding, granulating, or pelletizing plastic materials.
Representatives: Irwin Davlin, Michael De Luca, Jordan Cotton, Barnett J. Danson.

American Cyanamid Co.
Booths 906, 1005. Exhibit: Melmac molded melamine dinnerware; articles made from Cymac methylstyrene molding compounds; Cymel melamine molding compounds; Beetle urea molding compounds; Laminac polyester resins; Cymel melamine laminating resins; Melurac binder and adhesive resins.
Representatives: E. Bradshaw, R. Bush, S. Dahl, H. Day, H. Dudley, D. Estey, J. Grabowski, R. Head, J. Hoover, E. Hunt, B. Latta, G. Larson, D. McAfee, H. McVickar, R. Masur, J. Melchore, E. Michal, A. Nufer, G. Overholt, N.

Plastics Exposition, June 11th through 15th

Prince, I. Robertson, W. Sloatman, N. Sommer, F. Sorensen, J. Stanton, E. Trussell, W. Ward, T. Wennergren, H. West, W. Whitescarver.

American Plastics Corp.
Booth 615. Exhibit: Injection moldings; extrusions; vacuum formed parts; formed fibrous glass-reinforced parts; compression molded parts.
Representatives: Walter J. A. Connor, F. William DeBree, Marshall Sangster, Walter Opp, Roland Barrat.

American Tank and Machinery Corp.
Booth 308.

Amos Molded Plastics Div., Amos-Thompson Corp.
Booth 206. Exhibit: Injection molded parts and flexible packaging.
Representatives: Dale Amos, J. C. Kazimier, Frank D. Dell, Henry L. Conover, Fred Cole, R. W. Dailey, Harold Sorensen, Henry J. Kazimier, Roger Goin.

Anchor Plastics Co., Inc.
Booth 327. Exhibit: Samples of precision-extruded shapes; rods, strips, tubes; fabricated extruded components; curved extrusions; and cored extrusions; using acetate, Tenite II, styrene, Ancorene, Aeroflex, Ethocel Lucite, Plexiglas, and nylon.
Representatives: Richard A. Fisch, Myron Rothman, Jay B. Shapiro, Franklin Dick, Peter H. Seckel, Robert Marx.

Apex Machine Co.
Booth 416.

Archer-Daniels-Midland Co.
Booths 322, 324.

Atlas Vacuum Corp.
Booth 1238. Exhibit: Vacuum and press sheet forming machines; fabricated parts; Swedish steel clicking dies.
Representative: David B. Zelnick.

Auto-Vac Co., The
Booth 1142.

Automatic Molding Machine Co.
Booth 1110. Exhibit: Auto-mold fully automatic compression molding press.
Representatives: John A. Alesi, Arnold Schott, Irving Tochner.

Avery Adhesive Label Corp.
Booths 102, 201. Exhibit: Avery Kum-Klean and Perma-Grip pressure-sensitive labels; new automatic and manual label dispensers.
Representatives: E. W. Morris, C. J. Lee, M. A. Contreras.

B. I. P. Engineering Ltd.
Booth 1030. Exhibit: Hydraulic preformers; compression and transfer presses.
Representatives: Ralph B. Symons, Glenn A. Tanner.

Bakelite Co., a Div. of Union Carbide & Carbon Corp.
Booths 809, 813, 817, 835. Exhibit: Bakelite plastics and resins.

Baker Brothers, Inc.
Booths 719, 721. Exhibit: Automatic compression presses.
Representatives: M. W. Oberle, R. W. Marsh, L. Ninneman, H. Heath.

Ball & Jewell, Inc.
Booth 725. Exhibit: Three all-steel granulators; hopper-heater-dryer.
Representatives: C. W. Ball, Stewart M. Wood, Robert Ball, Raymond S. Portner.

Balsa Ecuador Lumber Co.
Booth 1219. Exhibit: Core materials for reinforced plastics.
Representatives: Henri Kohn, Jacques Kohn, Norman Kohn, Dick Mark.

Barber-Colman Co., Wheeler Instruments Div.
Booths 1106, 1108. Exhibit: Instrumentation; extrusion machines.
Representatives: R. A. Schoenfeld, H. H. Keckhefer, E. Hefferman, H. Proske, J. Wright, J. Sauerman, W. Karslo, J. Hancock, R. Hemman, F. Theil, R. Channell, B. Ramthun, H. Shugars.

Barrett Div., Allied Chemical & Dye Corp.
Booths 1029, 1035. Exhibit: Alkyd, nylon, urea, and melamine molding compounds; polyester resins for premix moldings; polyurethane foams and reinforced laminates; coating resins; foundry resins; and other industrial resins.
Representatives: C. E. Ellis, Jr., H. W. De Vore, E. A. Johnson, R. K. White, H. A. Voskamp, Jr., D. Delaney.

Bassons Industries Corp.
Booths 636, 638. Exhibit: Reinforced plastics products: bathtubs, helmets, three-wheel auto, parabolic projection screen, sinks, trays, gift ware; Styrene cases, novelties, helmets.
Representatives: G. Lubin, A. Bossecu, W. Malkan, A. Dellerman, M. Martin.

Belding Corticelli Industries
Booth 505. Exhibit: Nylon resins for compression, extrusion, injection; solvent solutions and dispersions for coating.
Representatives: E. J. Page, S. L. Grapnel, Richard T. Kropf, Howard Smith.

Bigelow Fiber Glass Products.
Booth 942. Exhibit: Fibrous glass mats; woven roving; wide glass cloth.
Representatives: James W. Kearns, Jr., Herbert Tullgren, Herbert Davidson, Gerry Browne, Jack Paulen, Bernie Trachtman, Charles Pedersen.

Blacher, B.
Booth 323. Exhibit: Plastic materials cut to size on rolls; plasticized and semi-rigid (film and sheeting) perforated roll goods; vinyl fusing cement; plastics materials for movie screens.
Representatives: Leo Blacher, Pauline M. Blacher.

Borden Co., The, Chemical Div.
Booths 413, 415. Exhibit: Phenolic molding compounds; plastisol molding compounds.
Representatives: H. W. Cyphers, E. L. Kraft, Sam Zweig.

Bramley Machinery Corp.
Booth 122. Exhibit: Two mixers.
Representatives: B. M. Halpern, Max Luhne, Edward Zemanek, Isidore Haber, Margaret Greer.

Cadillac Plastic & Chemical Co.
Booth 404. Exhibit: General line of plastics materials; Plexiglas; Cadco cast acrylic rods and tubes; various end products made from the above materials.
Representatives: Robert B. Jacob, Richard J. Jacob, Glayden V. Fox, Henri Grier, Eugene Quinn, Jack Lake.

Camin Laboratories, Inc.
Booth 1217. Exhibit: Electroformed injection mold cavities.
Representatives: Samuel Sialkoff, Walter W. Burke, Dr. Payne, Dr. Levi.

Carbide and Carbon Chemicals Co.
Booth 1126. Exhibit: Flexol plasticizers, monomers; glycols and polyols; amine curing agents; solvents; intermediates for phenolic resins; plasticiser intermediates; monomer MG-1.
Representatives: R. L. Duncan, J. J. Morris, J. H. Mathewson, R. A. Corio, R. C. Bolts, J. M. Cole, E. R. Newton, H. E. Klein, G. A. Trigaux, J. Paul.

Cast Optics Corp.
Booth 702. Exhibit: Optically clear rigid plastic sheets.
Representatives: William E. Chapman, Norman Germanow.

Catalin Corp. of America.
Booth 836. Exhibit: Styrene and polyethylene molding and extrusion compounds; end use applications of industrial resins for laminating, textile finishing, woodworking, paper, foundry, glass and rock wool, cork, abrasives, etc.
Representatives: E. W. Bastian, J. B. Hyman, J. Weiss, V. W. Moss, P. A. Krentel, F. E. Hadley, J. A. Connolly, R. H. Deppe, J. H. Gaines, F. J. Giordano, W. M. Hupfel, B. T. Porter, W. F. Sporting, A. D. Veale, C. C. Benson, H. F. Cromwell, P. J. O'Connor, D. F. Reid.

Celanese Corp. of America, Plastics Div.
Booths 2, 205, 209, 213. Exhibit: Products fabricated from: cellulose acetate (cast and extruded film and sheet); Forticel cellulose propionate; polyethylene (sheet and film); Marco polyesters. Fotiflex (polyolefin resin for extrusion) will be introduced.
Representatives: E. W. Ward, J. W. Flynn, J. L. Patterson, R. J. Savage, M. Reynolds, D. S. Hopping, C. M. Reynolds, H. M. Leiter, E. H. Miller, W. R. Porter, B. F. Nelson, J. J. Begley, W. K. Woodruff, K. W. Kithil, W. M. Portar, S. W. Murray, D. P. Clarke, J. T. Growley, P. W. Kinney, E. Seitz, J. J. Coleman, Dr. W. P. Moeller, Miss H. Raymond.

Chemere Corp. (Montecatini, Soc. Gen.)
Booths 515, 517. Exhibit: Vipla polyvinyl chloride resins; end products of Vipla produced by Italian manufacturers: pipe, valves, film, bottles, etc.
Representatives: Lucio Lucini, Gerd Lester, Giovanni Lombardo, Giovanni Moretti.

Chicago Molded Products Corp.
Booths 526, 528. Exhibit: Custom molded parts; extruded thermoplastic sheet and film; small vacuum forming machine will form products from Campco sheet.
Representatives: James Johnston, John J. Bachner, Edw. Bachner, Jr., Robert Reynolds, James Bachner, Robert McCarthy, Richard Fornoff, Reg Couture, Hugh O'Reilly, Charles Fegley.

Chromium Corp. of America.
Booth 537. Exhibit: Stabilizers; flame retarders; vinyl coatings.

Ciba Co., Inc.
Booth 331. Exhibit: Epoxy resin materials.
Representatives: D. M. Joseph, F. E. Pschorr, E. N. Dorman, G. M. Scales, Dr. M. Wismer, J. B. Durra.

Claremont Pigment Dispersion Corp.
Booth 1129. Exhibit: Vinyl color pastes; vinyl and polyethylene color concentrates; vinyl printing inks; polyethylene and vinyl gravure printing inks; high-impact resin concentrates; gold inks and color pastes; polyester, polyurethane, and epoxy color pastes.
Representatives: James R. Jones, William W. Krause, Murray Marlowe, Hal-Curtis Felsher, Mark W. Neitlich.

Coating Products
Booth 417. Exhibit: Metallized acetate, butyrate, polystyrene, and Mylar.
Representatives: M. M. Mainthow, D. Herdrich, J. Abrams, S. Hirsch, I. Berman, C. Olson.

Comet Industries
Booth 1210. Exhibit: Newly developed drap and vacuum forming machines.
Representatives: Robert E. Kostur, J. Edward Kostur.

Commercial Plastics & Supply Corp.
Booth 525. Exhibit: Acetate; Plexiglas; Lucite; nylon; Teflon; Vinylite; polyethylene; polystyrene; Fiberglas; and laminates.
Representatives: Arthur E. Herman, Morton R. French, Donald I. Yarnall, Denis F. Sheils, George De Biasi, John Lauria, Jack Hoyt, Ronald C. Jones, Herbert Braverman, Donald Singer, Irwin Brody, Sol Triestman.

Conforming Matrix Corp.
Booth 805. Exhibit: Automatic spray painting machines; mask washing machines; spray masks; fixture and holding devices.
Representatives: Hamilton E. MacArthur, Milton T. Schimmel, A. M. McIntire, Leo McHue.

Consolidated Molded Products Corp.
Booth 312. Exhibit: Molded plastic products.
Representatives: J. W. Pillinger, C. E. Beacham, E. P. Reese, F. P. Quinn.

Consolidated Electrodynamics Corp.
Booth 706. Exhibit: Various vacuum gages; valves & pumps; 14- and 48-in vacuum coating units.
Representatives: H. Waldeck, K. Rolley, D. Stocking, M. Garber, C. Holderbaum, C. Northrup, W. Dolke, N. Flannigan.

Cosmos Electronic Machine Corp.
Booth 622. Exhibit: Heat-sealing equipment for special effects.
Representatives: M. S. Abraham, Gerald Lippman.

Craig Systems, Inc.
Booth 956.

Cumberland Engineering Co., Inc.
Booths, 5, 7.

Dake Corp.
Booth 1109. Exhibit: Hydraulic compression molding press molding fibrous glass-reinforced plastics.
Representatives: Robert J. Kelley, Paul A. Johnson, Jr., Charles N. Jacobson.

Danielson Mfg. Co., The
Booth 204. Exhibit: Samples of nylon moldings and extrusions.

Davis Plastics Co., Joseph
Booth 1112. Exhibits: Cellulose acetates; high-impact polystyrene; rods, films, and sheet; various uses of each.
Representatives: J. Davis, M. Davis, A. Davis, L. Steinhard, S. Shar.

Detroit Mold Engineering Co.
Booth 839. Exhibit: Standard mold bases and component parts; moldmakers' tools and supplies.
Representatives: L. J. Morrison, W. Kosobud, B. Crawford, J. Mate, R. Fox, D. Carter, R. Sullivan, N. Bauschek, F. Marra.

Devoe & Raynolds Co., Jones Dabney Div.
Booth 1117.

Dexter & Sons, Inc., C. H.
Booth 314. Exhibit: Specialty papers.
Representatives: B. F. Conner, Jr., D. D. Coffin, Jr., H. V. Fleming, E. P. Grace, Jr., E. E. Card, Jr.

Dorris Process Co.
Booth 845. Exhibit: Metallized Mylar laminates.
Representatives: Messrs. Rosenblatt, Faber, Ruen.

Doven Machine & Engineering Inc.
Booth 1141.

Dow Chemical Co., The
Booths 1017, 1025. Exhibit: Saran, polyethylene, Styron polystyrene, Ethocel ethylcellulose, and polyvinyl

chloride molding compounds.
Representatives: Donald L. Gibb and others.

du Pont de Nemours & Co., Inc., E. I., Film Dept.
Booths 328, 332. Exhibit: Working model of a new cost comparator; demonstrations of the properties of Mylar polyester film; case histories of present uses for Mylar with special emphasis on decorative surfacing.
Representatives: W. B. Davis, R. C. Krueger, R. C. Myers, A. M. Kneitel, J. C. Dilts, J. P. Wilkins, M. L. White, D. L. Ormond.

du Pont de Nemours & Co., Inc., E. I., Polychemicals Dept.
Booths 221, 225, 231. Exhibit: Complete line of Du Pont plastics and resins.
Representatives: M. Powell, G. Nielson, D. O'Flynn, G. Moore, C. Carr, L. Ferris, R. Mallouk, I. E. du Pont, R. Brady, W. Ryan, M. Roedel, R. Manning, E. Keller, E. Grabille, H. Cadot, L. Sherwood, J. Ullman, H. Lecky, K. Clarke, M. Kubico, J. Hood, E. Darden, L. Paggi, Dr. E. Bernhardt, K. Persak, J. Paton, R. Leary, C. Winter, R Lescher, J. Shaw, L. Bell, W. Leech, M. Shaw, W. Amberely, M. Taylor, C. Waugh, B. Barnes, A. Pavlic, S. Berdan, E. Widlund, T. Woodworth, M. Collette, C. Foret, D. James, C. Patterson, J. Dockum, Donn Skoog, A. Thompson, W. Wall, S. Dougherty, A. Jefferey.

Dura Plastics, Inc.
Booth 301. Exhibit: Commercial products molded of acrylic.
Representatives: Joseph Layman, Samuel Baliner, Martin Marlowe, Seymour Sugarman, D. Wexler.

Durable Formed Products, Inc.
Booth 1118. Exhibit: Industrial parts vacuum formed of Plexiglas, Royalite, and Boltaron.
Representatives: Robert Gerardi, Daniel Lewis.

Durez Plastics Div., Hooker Electrochemical Co.
Booths 514, 516, 518, 520, 522, 524. Exhibit: Applications of phenolic molding compounds, phenolic resins, and Hetron fire-resistant polyester resins.
Representatives: F. C. Rowley, J. F. Ortner, L. J. Pentland, G. W. Wilcox, R. W. Bainbridge, E. F. Borro, Sr., G. A. Shroyer, R. M. Stroman, R. E. Dodd, J. W. Ferguson, F. W. Less, R. W. More, M. G. Dubenitz, H. B. Puff, E. J. Fuoco, C. Y. Cain, J. P. Edwards, C. I. Gochenour, A. L. Blackwell, R. J. Entenman.

Eastman Chemical Products, Inc.
Booths 1006, 1010, 1012. Exhibit: Several new plasticizers; Eastman cellulose acetate (dry powder) for extrusion; uses of Tenite acetate, butyrate, and polyethylene plastic materials.
Representatives: Spencer E. Palmer, David C. Williams, E. C. Catheart, W. H. Weaver, John Adams, J. T. Bent, W. P. Bussart, G. W. Carpenter, L. B. Connelly, W. F. Cooper, Jr., T. E. Dudney, C. B. Fox, Jr., W. P. Gideon, J. M. Lister, W. R. Groover, C. K. Harvey, Jr., J. F. Hill, T. H. Howard, R. P. Johnson, T. L. Loveless, J. M. Marvin, J. E. McKenzie, H. E. Moore, J. T. Moore, H. D. Oliver, Jr., Floyd Patrick, J. R. Pectal, W. L. Searles, C. L. Seay, J. G. Slater, N. C. Taylor, K. A. Wheeler, J. B. Williams, C. W. White, Jr.

Egan & Co., Frank W.
Booths 618, 620, 622. Exhibit: Extruder and accessory equipment.
Representatives: W. H. Willert, D. V. Blatter, R. C. Sturken, L. W. Egan, A. G. Russell, A. M. Johnsrud.

Elastomer Chemical Corp.
Booth 801. Exhibit: Vinyl foam products.
Representatives: Henry E. Allen, Charles W. Manzione.

Electromold Corp.
Booth 307. (See Stokes Trenton, Inc.)

Elgood Materials Corp.
Booth 108.

Emery Industries, Inc.
Booths 1002, 1004. Exhibit: Plastolein plasticizers
Representatives: R. F. Brown, R. T. Hull, A. C. Fusaro, J. D. Farr, J. W. Ritz, J. P. Clancy, J. E. Quinty, W. J. Siemens.

Emet Vacuum Forming Corp.
Booth 1242. Exhibit: Vacuum formed displays; packaging; industrial and toy parts.
Representatives: Edward Adler, Michel Schwartz, Pincus Pesso, Barrie Kent..

Entoleter Div., The Safety Car Heating and Lighting Co., Inc.
Booths 617, 621. Exhibit: Entoleter impact mill for particle size reduction and blending.
Representatives: R. J. Hoskins, R. A. McGrath, P. Whetstone.

Erdco Engineering Corp.
Booth 13.

Erie Resistor Corp.
Booth 305. Exhibit: Injection molded parts demonstrating "three dimensional finishing;" industrial applications; Erieflex lenses, etc.
Representatives: W. C. Conroy, E. L. Garloch, W. J. Brosman, V. M. Stilson, Berny Will.

Escambia Bay Chemical Corp.
Booths 1220, 1222. Exhibit: Plastics raw materials; polyvinyl chloride resin.
Representatives: R. U. Haslanger, D. J. Stark, W. W. Peacock, Jr., Dr. N. C. Robertson, Dr. W. Mayo Smith, H. W. Boynton, R. W. Brown, J. M. Gafford, J. T. Barr, Jr., R. S. Holdsworth, W. A. McMinn, A. Di Nardo.

Exact Weight Scale Co.
Booth 730. Exhibit: Weigh feeder for injection molding machine; weighing machines; scales.
Representatives: W. A. Schuerer, J. E. Konkle, W. T. Monroe, R. M. Rapp.

Famco Inc., Div. American Air Filter Co.
Booth 947.

Farley & Loetscher Mfg. Co.
Booth 123. Exhibit: Decorative high-pressure laminates; completely fabricated tops for homes, institutions, hotels, motels, and restaurants.
Representatives: C. E. Walz, R. J. O'Brien.

Fellows Gear Shaper Co., The
Booths 405, 407, 409. Exhibit: Injection molding machine.
Representatives: J. Hronek, D. E. Flint, F. Zumstein, F. C. Means.

Ferro Corp.
Booths 1130, 1132, 1134. Exhibit: Ferro Uniformat; Ferro colors; Ferro stabilizers for use in reinforced plastics and vinyls.
Representatives: Robert E. Lally, Stan Elliot, Bill Coloe, Marvin Butler, Dow Moore, Russell Duncan, James Simpson, Bernard Murray.

Fiberesin Plastics Co.
Booth 631. Exhibit: Decorative-faced solid plastic board stock; school, office, and furniture applications of Fiberesin.
Representatives: David McCalla, Robert W. Healy, John M. Daggett.

Fiberite Corp., The
Booth 325. Exhibit: High-impact reinforced phenolic and melamine materials; molded parts.
Representatives: John E. David, David Sharpe, Edwin Keusch, Paul E. Fina.

Filon Plastics Corp.
Booth 519. Exhibit: Filon translucent fibrous glass-reinforced plastics panels.
Representatives: Hugh Aronson, Robert Ernst.

Finish Engineering Co., Inc.
Booths 740, 742. Exhibit: Spray painting masks; spray painting machines; paint wiping machines; mask washing machines; stainless steel decorating screens.
Representatives: Robert B. Way, Carl Hersey, C. V. Scantlebury, Richard Morris, George Gardner, Robert Noll.

Firestone Plastics Co.
Booth 831, 835. Exhibit: Exon vinyl resins and products.
Representatives: L. B. Kuhn, H. E. Kellenberger, R. W. Briner, J. Rosenson, T. A. Henry.

Flexigrip Inc.
Booth 114. Exhibit: Zippers; plastics bags with zippers.
Representatives: Steven Ausnit, Emil Svec, Otto Kraus, Belle Tulka.

Furane Plastics, Inc.
Booth 1103. Exhibit: Epoxy and Furane pastes; coatings; castings; laminating compounds.
Representatives: Wm. Dewar, John Delmonte, L. F. Doyle.

General American Transportation Corp.
Booth 918. Exhibit: Injection and compression moldings; vacuum forming; reinforced plastics custom molded products.
Representatives: H. M. Jenkins, C. E. Holmes, J. R. Todd, J. D. Braught.

General Electric Co., Chemical Materials Dept.
Booth 302, 303. Exhibit: Special grade electrical, general purpose, and one-stage phenolic molding compounds.

General Tire & Rubber Co., The
Booths 712, 718.

Gering Products, Inc.
Booths 944, 945. Exhibit: Thermoplastic molding powders; polyethylene film; acrylic sheets; garden hose; dry colorants; compounding and custom extrusion services.
Representatives: Thomas I. O'Connor, Paul D. Holran, David Levine, Marty Landau, William Nathan, Sam Bell, Mike Sherman, James D. Oakley, Wayne Schrag, Julian Lanza, John Simmons, James Sykes, Harry E. Els, Irwin Stern, Paul R. Langevin.

Gilman Brothers Co., The
Booth 118. Exhibit: Materials.
Representatives: Lawrence M. Gilman, Charles M. Gilman, D. Edward Broadbent.

Glass Laboratories, Inc.
Booth 521. Exhibit: Plastic "brass" Silvatrim, "chrome" Silvatrim, "copper" Silvatrim.
Representatives: Jesse P. Shanok, Victor Shanok, Irving Jacobs.

Glengarry Equipment Corp.
Booth 330. Exhibit: Weigh feeders for injection molding machines.
Representatives: J. E. Currie, C. W. Lang, E. A. Buechner, L. R. Kent.

Glenn Electric Heater Corp.
Booth 736. Exhibit: Electric heating equipment.
Representatives: T. A. Bothwell, I. G. Glenn, D. G. Glenn, H. N. Cahnman, T. Mann, M. Glenn.

Goodrich Chemical Co., B. F.
Booths 422, 426. Exhibit: Finished products made from Geon polyvinyl materials.
Representatives: J. C. Richards, A. I. Brandt, R. F. Dettelbach, W. E. Manring, C. D. Segner, H. L. Wuerth, W. D. Lahey, E. B. Osborne, H. F. Engler, H. E. Boland, S. G. Madden, M. D. McClusky, R. E. Koester, C. A. Brown, G. B. Koch.

Goodyear Aircraft Corp.
Booth 1113.

Goodyear Tire & Rubber, Co., The, Chemical Div.
Booths 806, 810. Exhibit: Pliovic vinyl resins; Plio-Tuf high-impact styrene resins; Plio-Tuf colored pellets; products postformed from laminated Plio-Tuf sheet; Pliovic in electrical applications.
Representatives: H. R. Thies, R. E. Workman, C. O. McNeer, R. S. Earhart, A. E. Polson, E. C. Brown, J. Carraher, J. R. Houlette, E. F. Gibbons, J. M. Hussey, H. D. Allick, J. W. Bear, J. M. Jones, W. F. Gerrow, R. Wallace, L. P. Thies, R. R. Kann, F. W. Milward, W. E. Kelly, R. G. Luskin, H. S. Soil, K. K. Fligor.

Gougler Machine Co., C. L., The
Booth 1236. Exhibit: Machining facilities available for the complete production of molds used in the molding of all types of plastics materials.
Representative: John C. Moricoli.

Guild Electronics Inc., Dynatherm Div.
Booth 1101. Exhibit: Industrial radio frequency generators and heat-sealing units.
Representatives: William Fienstien, Robert Farkas, Sol Schwartz, Anthony Crupi, Jr.

Gurey Mfg. Co.
Booth 743. Exhibit: Squeezing conveyor for fusing plastic; assembly conveyor.
Representative: S. J. Gurey.

Harburger Eisen und Bronzewerke A. G.
Booths 739, 741.

Hartig Engine & Machine Co.
Booth 1114. Exhibit: Plastic extruder and components.
Representatives: L. D. Yokana, Edward Greene, Donal Fisher, William Torres.

Hays Mfg. Co., Reinforced Plastics Div.
Booth 126. Exhibit: Glass-reinforced laminated sheet stock; reinforced molded parts for the electrical industry.
Representatives: Ernest L. Taylor, R. D. Beard, E. E. Wilson, Philip Andress, L. K. Detwiler, J. D. Clemens, Wm. Forster.

Heinrich Co., H. H.
Booths 1144, 1146. Exhibit: Extrusion and take-off equipment.
Representatives: H. H. Heinrich, K. R. Sunderhauf, H. P. John, A. H. Winkler, Fred Reifenhaeuser.

Hendrick Mfg. Corp.
Booth 511. Exhibit: Panel saw for sizing and trimming plastic sheet stock.
Representative: R. W. Hendrick.

Hercules Powder Co., Inc.
Booth 830. Exhibit: Consumer and industrial products molded of Hi-fax, Penton, and Herocoel; demonstrations of the physical properties of these materials.
Representatives: Reed Combs, Philip Robb, Homer Simmons, Werner Brown, James Skelly, Carl Eurenius, Benjamin Brown, Russell Hanna, Sam McElroy, Bruce Oakley, Paul Metzger, Cyril Sidun, Robert Stover, George Taylor, Jack Martin, Daniel Welsh, William Bracken, LeRoy Barnette, Walter Gloor, Edward Cronin, Paul Johnstone, Emmett Hixon, Joseph Coughlin, Philip Belk, George Boesert.

Hopp Plastics Div., The Hopp Press Inc.
Booth 123. Exhibit: Printed, laminated, die cut, and formed plastics products.
Representatives: George Hopp, Philip Hopp, E. Autler, Wm. Greenberger, Gerald Hopp, Richard Hopp, Wm. Gleim, E. Manning.

Hull-Standard Corp.
Booth 535. Exhibit: Two types of Hull-Standard automatic presses.
Representatives: L. W. Hull, J. L. Hull, Maclean Brown.

Hurlbut Paper Co.
Booth 732. Exhibit: Specimens of absorbent papers for decorative and industrial laminates.
Representatives: E. A. Sitzer, James M. Burt, Lester L. R. Phillips, James M. Farnum, Edward R. Stacy, Dr. H. F. Arledter.

Hydraulic Press Mfg. Co., The
Booths 111, 113, 115, 117, 119. Exhibit: Injection molding machines in operation.
Representatives: Tom G. Bishop, Dale Mosher, Burke Weisend, Frank Chute, C. P. Terry, B. D. Ashbaugh, A. S. Linzell, John Parks, C. J. Ziegfeld, E. L. Oehling, W. L. Croll, W. H. Bennett, John C. Coonley, W. R. Schreck.

Hy-Sil Mfg. Co. and High Vacuum Metals Inc.
Booth 234. Exhibit: Metallized plastic films and laminations.
Representatives: Walter Scharf, Richard Silverman, Lester Fields, E. Dunham.

Improved Machinery Inc.
Booths 1040, 1042. Exhibit: Injection molding machines in operation.

Industrial Mfg. Corp.
Booths 1120, 1122. Exhibit: Thermolators.
Representatives: W. E. Ellsworth, H. A. Meyrick.

Industrial Research Laboratories, Div., Honolulu Oil Corp.
Booth 134. Exhibit: Xaloy bimetallic extruder cylinders.
Representatives: Edwin A. Brown, Earl R. Rountree.

Instron Engineering Corp.
Booths 110, 112. Exhibit: Testing instruments; accessories.
Representatives: Harold Hindman, George S. Burr, Henry W. Cook.

Interchemical Corp.
Booths 1032, 1036. Exhibit: Various end products fabricated from IC coatings, polyester resins, IC valley printing inks; IC Vynafoam (expandable liquid-plastic); IPI flexographic inks for plastic films; R-B-H color concentrates for extrudable thermoplastics, plasticols, and vinyl sponge.
Representatives: Paul O. Blackmore, Bert Breaky, L. H. Conklin, Jr., O. C. Holland, Al Howell, R. L. Lynch, Samuel A. Moore, Calvin Remacle, Chester Robbins, Walter Rost, Douglas Tuttle.

International Balsa Corp.
Booth 310. Exhibit: Balsa wood as a core material for reinforced plastics products.
Representatives: Prem Gary, S. Greenhouse.

Kellogg Co., The M. W.
Booths 804, 901. Exhibit: Kel-F plastic and its applications.
Representatives: W. J. Merck, S. W. Jones, Jr., M. E. Conroy, J. H. Detwiller, D. L. Duncan, L. J. Fitz-Harris, C. R. Giannotta, J. A. Jupa, F. J. Kane, F. M. Ruggles, D. W. Towler, C. K. Travis, F. W. Troester, A. R. Weik, A. L. Dowling.

Kingman Co., E. B.
Booth 106.

Kohnstamm & Co., Inc., H.
Booth 1235. Exhibit: Dry colorants for plastics.
Representatives: G. Sloane, Arthur Vogel, Paul Kohnstamm, T. O'Brien, Jesse White, A. Sottolano, Robert Woolf, W. Olson, E. Murphy, Dr. S. Zuckerman.

Koppers Co., Inc., Chemical Div.
Booths 414, 416. Exhibit: Products molded of Dylan Polyethylene, super Dylan polyethylene, Dylene polystyrene, and Dylite expandable polystyrene.
Representatives: C. H. Pottenger, J. W. Pool, Jr., R. R. Sarchet, J. B. Schmitt, L. R. Hunter, W. J. Fitzgerald, Dr. J. F. Corwin, E. A. Edberg, H. D. Cooper, C. J. Runfola, R. V. Bridi, M. J. Sills, C. H. Marquardt, W. J. Catrow, P. E. Cornyn.

L. O. F. Glass Fibers Co.
Booth 306. Exhibit: Glass reinforcements: Garan roving, Vitron roving, chrome roving, chopped strand, mat, woven roving, glass cloth, and microfiber paper.
Representatives: D. W. Lyon, G. L. Smead, T. L. Carver, Don McAnally, W. R. Browne, R. H. Garnett, E. A. McCabe.

Lafayette Saw & Knife Co.
Booth 1206.

LaRose & Assoc., Inc., W. T.
Booth 406. Exhibit: Thermall high frequency preheating equipment.
Representatives: J. W. Keyes, J. F. Trembley, J. T. Arnold, S. T. Miles, V. S. Wagner, W. T. LaRose.

Lemmon & Snoap
Booth 1240. Exhibit: Carbide-tipped saws; machine in operation will cut different materials to show kind of cut obtained with a carbide saw.
Representatives: K. R. Lemmon, L. A. Snoap, R. Lou Painter.

Lester-Phoenix, Inc.
Booth 226, 232. Exhibit: Lester 4-oz. automatic injection molding machine.
Representatives: D. White, D. J. Sloane, W. H. Schwartz, E. C. Mast, J. J. Schmidt, M. R. Tenenbaum, D. Williams, S. W. Lohman, A. B. Geers, S. F. Krould, J. Geers, M. Barron, R. Neubecker, H. Putsey, J. Morton.

Lewis Welding & Engineering Corp., The
Booth 726. Exhibit: Injection molding machines.
Representatives: J. T. Lewis, Jr., E. W. Hollis, C. E. Miller, W. A. Pearse, Jr., C. A. Crabiel, L. Markel.

Lincoln Plastics Corp.
Booth 1229. Exhibit: Industrial molded articles; thin walled containers; industrial components.
Representatives: M. W. Burkhart, J. K. Petty, A. D. Berry, C. J. Luster.

Logan Engineering Co.
Booths 1231, 1233. Exhibit: Automation in plastics with hydraulic preformers; molding machines and handling systems equipment to be in operation.
Representatives: Mel Lawrence, Sam Kostelny, Stan Logan, Geo. Logan, Ad Smith, Henry Drake, Marty Lipton, Bill Fors, Jim Stewart, Larry Hunt, Ted Casper, John Magnus.

Macbeth Daylighting Corp.
Booth 701. Exhibit: Color matching light.
Representatives: W. B. Reese, R. E. Meeker, W. W. Heironimus.

Markem Machine Co.
Booth 1139. Exhibit: Marking machines and various other related equipment.
Representatives: R. C. Mensel, S. W. Raymond, D. F. Putnam, J. Baute, D. C. Emery.

Martin Processing Co.
Booth 513.

Materials & Methods and Reinhold Publishing Corp.
Booth 437. Exhibit: Publications.
Representatives: William P. Winsor, M. R. Long, A. E. Fountain, B. Smith, P. O'Keefe, A. S. Hale, G. L. Fox, D. W. Huettner, H. C. Eagar, H. R. Clauser, J. B. Campbell, J. L. Everhart, M. W. Riley, W. M. Weiss, S. W. Conkling, R. J. Fabian, F. P. Peters, G. G. Hawley, J. McKible, H. M. Beckman.

Mayflower Electronic Devices, Inc.
Booth 321. Exhibit: Rotary high frequency sealer; various generators, presses, and sealing equipment.
Representatives: Edward J. Wobefarth, Jack Stewart, Harold Coleman, Larry Smith.

Metal & Thermit Corp.
Booths 1213, 1215. Exhibit: Stabilizers and flame retarders for vinyls; plasticols.
Representatives: E. Tinnon, B. Brooks, G. Betz, C. Palkie, D. Meserve, M. Turkdarian, J. Bouchoux, F. Haas, W. Grant, G. Smolka, M. Peres, W. Brodin, R. Berry, F. Scott.

Miller Engineering Laboratories, Inc.
Booth 507.

Modern Plastics Machinery Corp.
Booth 208. Exhibit: Photographs and literature on company and products; samples of extruded products will also be shown.
Representatives: W. J. Johnson, Edward Tanis, Stanley F. Bloyer, Neill Rothacker.

Modern Plastics Magazine
Booth 826. Exhibit: Publications.
Representatives: C. A. Breskin, A. S. Cole, P. H. Backstrom, M. A. Olsen, B. W. Gussow, S. S. Siegel, R. C. Nilson, B. Stanton, J. M. Connors, W. F. Kennedy, H. Friedman, R. C. Beggs, H. McCann, A. P. Peck, R. L. Van Boskirk, Dr. J. F. Carley, V. Wright, J. Frados, I. Gross, W. Lubars, P. W. Muller, R. B. Birnbaum.

Molded Fiber Glass Co.
Booths 729, 731. Exhibit: Inner door panels for refrigeration equipment; loud-speaker horns; lamp shades; chairs; business machine housings; automobile body parts; wastebaskets; laundry tubs; filter press plates; colored flat sheet; and various other large parts fabricated of fibrous glass-resin laminate.
Representatives: Herb Gordon, Lauren "Bud" Palmer, William Helm, Harold Ogust, Alan Henry, Frank Kelsey, Bob Gilbert, Ed Richlin.

Monsanto Chemical Co., Plastics Division.
Booths 905, 909, 913, 917. Ex-

hibit: Model of Monsanto "House of Tomorrow." Experimental car interior featuring plastics.
Representatives: E. L. Hobson, T. S. Lawton, D. S. Plumb, E. S. Childs, D. Guarnaccia, C. L. Richards, F. E. Woodill, R. F. Hansen, C. F. Trombley, E. D. Kennedy, J. P. Skehan, R. C. Evans, M. G. Caine, R. W. Riedel.

Montecatini, Soc. Gen.
(See Chemore Corp.)

Moslo Machinery Co.
Booths 628, 632. Exhibit: Two 2-oz. fully automatic injection molding machines; one will mold a 12-oz. container; the other will mold the lid for the container.
Representatives: E. P. Moslo, B. J. Moslo, P. P. Sorensen, Robert Dean.

Motson Co., J. Frank
Booth 116. Exhibit: Printing on plastics, glass, and metals, such as industrial parts, electronic parts, flat sheets, molded parts, laminated parts, tubes, etc. Methods used will include letter press, offset, silk screen, photographic, electroformed-mask spray.
Representatives: J. Frank Motson, George R. Stewart, Ridgeway T. Haggerty, Wm. L. Berlinghof, John Crossdale.

Nash Co., Inc., J. M.
Booth 1136. Exhibit: Nash Multi-Spindle Rotary finishers.
Representatives: Robert Greene, J. A. Christensen, A. Kluge.

National Lead Co.
Booth 1039. Exhibit: Stabilizers for the plastics industry.
Representatives: J. G. Collins, Walter Weithas, H. J. Ratti, A. L. Scarbrough, P. W. Rizzo, E. G. Gordon, W. Schaeffer, C. Eichhorn.

National Research Corp., and Foiltone Products, Inc.
Booth 713. Exhibit: Vacuum coating equipment; vacuum coated products; large rolls of plastic sheets which have been coated by a continuous process.
Representatives: S. Sydney Minault, Paul Patton, Howard Farrow, Golbert King, Jr., David Preis, Allan Dragone, Wesley Mansir, Phillip Clough, Gordon Kiddoo.

National Rubber Machinery Co.
Booth 410. Exhibit: Extrusion equipment.
Representatives: H. E. Buecken, R. K. Senn, W. G. Potts, E. R. Coddington, J. R. Heiser, W. B. Rogovy, A. DeGhetto, A. Sala, M. L. Zanetti, C. S. Gilbert, F. J. Maywald.

Naugatuck Chemical Div., U. S. Rubber Co.
Booths 812, 818. Exhibit: Materials and products.
Representatives: W. J. Geldard, E. J. Geise, H. C. Bendel, D. A. Edwards, R. H. Malamphy, C. Miner, Jr., A. Herring, E. E. Finney, H. C. Colby, R. P. White, E. H. Brown, A. K. O'Keefe, D. Cowell, W. H. MacHale, W. F. Lavelle, W. DeC. Crater, Paul Elliott, Ivan Mankowich, R. G. Nelb, A. J. Lombardi.

New Hermes Engraving Machine Corp. and Hermes Plastics.
Booth 105. Exhibit: Portable- and bench-type engraving machines; flexible plastic engraving stock.
Representatives: N. Schimmel, W. Dannheisser, G. Greutner, M. Kaufman, R. H. Laird.

Newark Die Co.
Booth 531. Exhibit: molds; hobbings; small automatic injection molding machine.
Representatives: Max Wohlleben, Islyn Thomas, Ed. Spitzig, Nathan Miksch, Joe Burke, Robert Mungall, Harry Taylor.

Newbury Industries
Booth 948.

Nixon Nitration Works
Booths 315, 317. Exhibit: Plastic rods and tubes of cellulose acetate, cellulose acetate butyrate, and ethyl cellulose; sheeting of cellulose acetate, cellulose acetate butyrate, rigid vinyl, ethyl cellulose, modified styrene, low impact polystyrene; samples of various items made from the above materials.
Representatives: M. Breitkopf, A. J. Baldwin, M. W. Peters, W. B. Savage, W. A. Olsen, W. G. Tucker, K. P. Whiting, G. L. Lotz, Z. Crocker III, R. Ford, C. A. Dovidio, Nancy Rucker, Katharine Page, S. W. Nixon, L. Ohye.

Nopco Chemical Co., Metasap Chemical Co., Griffin Chemical Co.
Booths 946, 1041. Exhibit: Lockfoam (foamed-in-place urethane plastics) and Nopcofoam (flexible cellular foamed plastics); uses of stearates (metallic soaps) in material compounding, molding, and in the vinyl floor covering field; polyvinyl acetates and various plasticizers.
Representatives: George Stier, Ben Collins, J. Gulick, Dr. B. Dombrow, R. Ward, R. Singer, K. Holton, D. M. MacGregor.

Ohio-Apex Div., Food Machinery & Chem. Corp.
Booth 841. Exhibit: Plasticizers for thermoplastics; Dapon resin, a prepolymer of diallyl phthalate; diallyl phthalate and other allyl monomers.
Representatives: Bert S. Taylor, Norman S. Mount, F. L. Hemingway, Ray Phillips, James Thomas.

Omni Products Corp.
Booth 432. Exhibit: The company's function, as distributing and export representatives, of making available American and Canadian materials, machinery, and methods to foreign markets.
Representatives: T. Perutz, G. L. Ottens, W. Geber.

Owens-Corning Fiberglas Corp.
Booth 420. Exhibit: Fiberglas reinforcing products such as yarns, rovings, mats, fabrics, cut strands; molding compounds; and several reinforced plastic parts.
Representatives: M. T. Nemeyer, P. Williams, C. E. Bacon, J. H. Thomas, W. K. Keller, Geo. Irvine, Jan Irvine, L. Polhemus, J. Dougherty, W. Bren, S. Mandel, B. Cobb, Jr., John McBride.

Pantex Mfg. Corp.
Booth 11.

Phillips Chemical Co.
Booths 840, 939. Exhibit: Marlex 50 polyethylene in pellet form as it is bagged at plant; pictures and written information to describe properties and uses of Marlex 50; manufactured products such as housewares, film, pipe, wire and cable coverings, etc.
Representatives: R. G. Askew, W. R. Barret, M. B. Bistline, G. F. Blinzler, J. S. Brown, W. R. Clark, L. B. Croley, W. C. Douce, L. E. Hoffman, R. V. Jones, W. M. Larsen, J. T. Roach, C. R. Scott, D. E. Setter, C. J. Silas, J. V. Smith, R. L. Smith, R. F. Uber, R. M. Wallace, A. L. Walters, G. Walsh.

Pittsburgh Coke & Chemical Co., Plasticizer Div.
Booths 624, 626. Exhibit: Plasticizers: maleic anhydride, phthalic anhydride, fumaric acid, phenol, ortho cresol, meta para cresol.
Representatives: Henry Avery, Duncan J. MacLennan, John L. Frothingham, Edward H. Winkleman, Walter H. Daub, Jr., Harry W. Dudley, Thomas H. Boyd, Richard J. Murphy, Edison H. Shaw, Raymond M. Wolber, James F. Hall, Jr.

Plastics Engineering Co.
Booth 137. Exhibit: Products molded of Plenco phenolic molding compounds and Plenco synthetic phenolic resins.
Representatives: R. T. Brotz, E. H. Beach, Fred Puls, Crane McAtee, W. F. Selsmeyer.

Plastics Technology Publishing Co.
Booth 313. Exhibit: Publications.
Representatives: Arthur Merrill, James T. Dugan, Lee Van Jones, William Bisson, Robert Carter, Raymond Bill.

Plastics World, Cleworth Publishing Co.
Booth 902. Exhibit: Publications.

Plax Corp.
Booth 926. Exhibit: Packages made from Plax sheet and film products; containers formed from trial materials for evaluation purposes. Emphasis on biaxially oriented sheet, especially Polyflex, with various applications and special stress on lighting panels.
Representatives: C. N. Sprankle, J. S. Milne, R. W. Major, P. S. Rath, R. V. Minogue, J. J. Barile, W. P. Fox, W. Bolton, L. Cermola, E. S. Marsh, J. W. Carlile, A. V. Todd.

Plaxall Inc.
Booth 802. Exhibit: Complete range of precision formed plastics manufactured on automatic equipment.
Representatives: Louis H. Pfonl, Gary Menkel, Peter Morse, William Hogensen.

Polyform Plastics Corp.
Booth 319. Exhibit: Various types of extrusions, including welts, channels, stripping, and tubing.
Representatives: Mandel Kuber, Alvin Steinberg, Sam Rose, Michael Bialy.

Polyplastex United, Inc.
Booth 1225. Exhibit: Decorative vinyl laminates.
Representatives: R. W. D. Heins, E. G. Ottley, H. M. Fischer.

Post Machinery Co., Electronic Products Div.
Booths 15, 17.

Prodex Corp.
Booths 1009, 1013. Exhibit: Extruders and accessories.
Representatives: F. R. Nissel, A. A. Kaufman, A. F. Scarpa.

Product Engineering
Booth 222. Exhibit: Publication.

Radial Cutter Mfg. Co.
Booth 509. Exhibit: Various plastics and laminated materials; Radialloy-tipped saw blades; standard saw blades; Radialloy-tipped router bits; saw tables.
Representative: George S. Mackrin.

Radio Corp. of America
Booth 1105.

Radio Receptor Co., Inc., Thermatron Div.
Booth 326. Exhibit: Electronic sealing machinery; automatic and semi-automatic feeding equipment; samples of finished products.
Representatives: Ivan H. Schwartz, Harold N. Krongold, Peter B. Black, George Steinberg, Richard C. Ballin, William Principe.

Rainville Co., Inc., The
Booths 1239, 1241. Exhibit: Scrap grinders; mold temperature control; injection machines; refrigeration units; hopper loaders; compression presses.
Representative: Dewey Rainville.

Reed-Prentice Corp.
Booths 1018, 1026. Exhibit: Injection molding and extruding machines.
Representatives: J. J. Kelly, J. H. Wolcott, J. D. Sherman, W. O. Elliott, D. G. Eaton, Eric Brierley, A. R. McIntyre, Neil Henry, C. J. Holland, C. L. Jasper, R. W. Carr, D. B. Stanley, I. J. Freeman, G. W. McIntyre, H. Corbett.

Reichhold Chemicals, Inc.
Booths 910, 912. Exhibit: Polyester and phenolic resins.
Representatives: Messrs. Kline, Patterson, Turner, Chancellor, Scala, Wooten, Helmrich, Morosco, Carter, Grosius, Schupp.

Reliance Electric Engineering Co.
Booth 23.

Richards Co., J. A.
Booth 32.

Roehlen Engraving Works, Inc.
Booth 1135.

Rohm & Haas Co.
Booths 419, 421, 425, 431. Exhibit: Plexiglas sheet and molding powder used in signs, lighting, store displays, architecture, industrial plants, automobiles, home appliances, personal accessories, industrial products.
Representatives: Dr. D. A. Rothrock, N. G. Wedemeyer, A. R. McFarland, D. S. Plume, R. L. Gardner, R. Schacht, R. R. Rorke, S. J. Zarger.

Rubber & Asbestos Corp.
Booth 1224. Exhibit: New developments in industrial adhesives for plastics to plastics and plastics to metal bonding.
Representatives: Jerome L. Been, Martin M. Grover, Harold Greene, John W. Bruce, Jr., Herbert M. Greene, Bernard Gould, Richard Firrera, Mel Hyams, Kenneth Kashdan, Myles McDonough, Charles Stachel, George Stanton, C. T. Williamsen.

Sandt, J., A. G. (DeWitt Lewis Co., American Agents)
Booth 1236. Exhibit: Four automatic cutting machines.

Sarco Co.
Booth 707. Exhibit: Temperature control for molds and cylinders; steam trap for compression presses.
Representatives: A. Milnes, M. J. Marion, J. Thompson, D. Roland, D. Mariner.

Scalomatic Electronics Corp.
Booth 1121. Exhibit: Two Electronic heat-sealing machines in operation.
Representatives: H. Perlman, Tony Alcano.

Shell Chemical Corp.
Booth 527. Exhibit: Resin in protective coatings, laminates, and electrical equipment.
Representatives: H. Howard, T. Walb.

Sommers Plastic Products Co.
Booth 842. Exhibit: Flexible plastics materials and finished items, such as handbags, belts, imitation leather, and advertising specialties.
Representatives: Herman J. Schecter, Sylvia Tuman, Irving Rifkin, Phil Schecter, Dieter Lissmann, Ursla Schneider, Matty Matlin.

South Florida Test Service
Booth 311. Exhibit: Colored photographs of test facilities for actual weathering, corrosion, sunlight, and storage exposure tests on plastics.
Representatives: E. M. Denoon, W. W. Smith.

Spencer Chemical Co.
Booth 237. Exhibit: Products made of polyethylene: greenhouse, insulation, pipe, housewares, toys, large castings, etc.
Representatives: W. Schopflin, Fred Sutro, George Olson, M. H. Straight.

Standard Tool Co.
Booths 1044, 1046. Exhibit: 25 and 50 ton injection molding machines in operation.
Representatives: John A. Kavanagh, Amelio Cocci, Gregory Asarian.

Steiner Plastics Mfg. Co. Inc.
Booths 401, 403. Exhibit: Products made from acrylic and fibrous glass.
Representatives: Malcom Steiner, Mark Steiner, Felix Lamarr, Robert Coombs, Henry Stauffer, N. Orange, A. Cohen, T. Gomes.

Stenegaard and Assoc. Inc., W. L.
Booth 212. Exhibit: Large vacuum formed plastic displays and devices.
Representatives: W. L. Stenegaard, Dane Hahn.

Sterling, Inc.
Booth 614. Exhibit: Sterico temperature control unit.
Representatives: John B. Ballard, C. H. Herrick, Lloyd Qually, Dewey Rainville, C. H. Whitlock, Nick Gerten, Peter Brandes, Harry J. Harp, Robert Arnold, Ray Horsefield, F. L. Bridges.

Stokes Machine Co., F. J.
Booths 31, 125, 127, 131. Exhibit: Automatic injection molding machine; 50-ton, fully automatic compression molding press; vacuum metallizer. All equipment will be in operation producing finished parts.
Representatives: Quentin M. White, E. J. Fitzpatrick, Frank Arpajian, J. Gordon Seiter, S. H. Greenwood, David E. Stokes, Jay Steiner, Walter Rayher, John Coleman, Ralph Stalbaum.

Stokes Molded Products
Booth 34. Exhibit: Custom moldings.
Representatives: J. A. Jackson, J. J. Ryno, T. E. Wallis, H. G. Clark, L. L. Manchester, E. I. Wood, M. R. Mashanski.

Stokes-Trenton Inc., and Electromold Corp.
Booth 307. Exhibit: Automatic compression and injection molds; electroformed mold cavities.
Representatives: Charles C. Davis, Jr., F. W. Klein II, J. W. Devey, R. P. Nolan, W. J. B. Stokes II, Charles Windham, John Reib, John Jundt.

Stromes Systems, Inc.
Booth 4. Exhibit: Industrial ovens for the plastics industry.
Representatives: P. W. Stromes, W. L. Gamory, F. W. Whiteside, A. Islors.

Swift & Sons, Inc., M.
Booths 1042, 1045. Exhibit: Method of marking, decorating, and designing on plastic, leather, wood, cloth, etc.
Representatives: Charles A. Ziroli, Charles F. Lemon, J. Wilson, Jonathan G. Swift, Donald D. Swift, V. L. McKelvy.

Thermaflow Chemical Corp.
Booth 844. Exhibit: High-impact reinforced polyester molding compound.
Representatives: R. Doyne, C. Cassidy, R. Busch, R. Keegan, R. Thomson, F. Staral.

Thermel Inc.
Booth 1205. Exhibit: Thermabands; Thermaplatens; Thermatubes; Thermaheaters; Thermacartridges; Thermafilm.
Representatives: W. H. Norton, D. H. May.

Tracerlab, Inc.
Booth 1140. Exhibit: Radiation gages for film and sheet thickness measurement; automatic controls for plastic film and sheet manufacturers.
Representatives: H. R. Taylor, K. N. Leondar, G. E. McKewen, H. S. Myers.

Unette Corp.
Booth 1232. Exhibit: Dispensers; applicators; saran packages.
Representatives: P. E. Moonan, P. L. Pyne, W. F. Foran, R. Kurtz.

U. S. Gypsum Co.
Booths 1102, 1201.

U. S. Industrial Chemicals Co., Div. of National Distillers Products Corp.
Booth 710. Exhibit: Polyethylene resins; isosebacic acid.
Representatives: V. D. McCarthy, G. M. O'Brien, A. Johnson, E. Richardson, G. Rementer, L. Vincent, W. O'Keefe, M. Faye.

U. S. Royalite Div., U. S. Rubber Co.
Booth 1212. Exhibit: Formed Royalite parts.
Representatives: T. R. Grimes, W. C. Schlager, H. W. Prentice, J. J. Cady, J. H. McFarland, A. I. Hanfling.

Vacuum Forming Corp.
Booth 1125. Exhibit: Vacform machine and auxiliary machines related to the vacuum forming process; vacuum formed products.
Representatives: Sanford S. Zimmerman, Rudolf Kreidel, N. V. Fasano, Dewey Rainville, Robert Shevett, Nicholas Gerten, Thomas Ryan, William Dunnican, J. C. MacKenzie, Max Klueger.

Vacuum Metallizing Corp.
Booth 704.

Van Dorn Iron Works Co., The
Booth 532. Exhibit: Automatic injection machine in operation.
Representatives: J. J. Reichel, H. H. McNash, E. Jaynes, R. Neubauer, G. Koch.

Wallace & Tiernan Inc., Harchem Div., Lucidol Div.
Booths 625, 627. Exhibit: Plasticizers; sebacic acid; organic peroxides.

Waldron Corp., John, The
Booth 107. Exhibit: Roll coating machine with precision roller bearings.
Representatives: D. G. Higgins, Emil Schnitzpohn, R. H. Markowitz, O. W. Grant, C. A. Dickhaut, A. W. Willenbrock, R. K. Newcomb, A. W. Pomper.

Wasco Products, Inc.
Booth 1203. Exhibit: Acrylic sheets with and without embedments.
Representatives: R. D. Pillsbury, Sumner Vivat.

Watson Stillman Press Div., Farrel-Birmingham Co., Inc.
Booths 215, 219. Exhibit: Preplasticizing-type horizontal injection molding machine in operation.
Representatives: H. Elliott, A. DeMatteo, R. Fehr, R. York, H. Genzken.

Welding Engineers, Inc.
Booths 214, 216, 218. Exhibit: Dual worm compounder; Formvac vacuum forming machine.
Representatives: Millard Demarest, George Howell, H. M. Harris, L. H. Heist, Jr., M. F. Loetterle, F. C. Schutz, L. F. Street.

West Instrument Corp.
Booth 1131. Exhibit: Temperature controllers; indicators; recorders; accessory equipment. All units will be operating.
Representatives: Richard K. West, William C. West, Jr., Ardmore M. Willer, Norman Biagar, William Gibson, Harold Hemming, Sid Lee, Francis Gamble, Earl E. Whitaker, George M. Tow.

Westchester Plastics, Inc.
Booths 1001, 1003. Exhibit: Custom coloring of plastics compounds for molding and extruding. Typical products are: squeeze bottles, "pearl" beads, belting, buckles, buttons, closures, etc.
Representatives: Joseph Jehle, Fred Peterson, Herbert Margrill.

Westinghouse Electric Corp.
Booth 925. Exhibit: Micarta, a laminated plastic, in many forms and grades for industrial use; various colors and patterns for decorative applications.
Representatives: E. F. Davies, George Sutton, E. E. O'Connor, P. H. Grunnagle, W. T. Rush.

Westlake Plastics Co., Crystal-X Corp.
Booth 309. Exhibit: Sheet, rods, and tubing made from methacrylate, polystyrene, polyethylene, and fluorocarbon.
Representatives: E. B. Westlake, Jr., E. F. Westlake, Walter F. Noonan, Jr., William H. Seiler.

Wheelabrator Corp.
Booths 216, 218. Exhibit: Automatic deflasher; dust and fume collector.
Representatives: R. L. Orth, G. O. Pfaff, B. H. Berger, A. H. Freeman, K. E. Blessing, David Logan, F. J. Pichard, F. E. Uhl, T. L. Fawcett, C. L. Benham, C. F. Ludwig.

Whitlock Associates, C. H.,
Booth 735. Exhibit: Hopper loader and hopper dryer in operation.
Representatives: M. G. Denny, C. H. Whitlock, R. J. Denny, H. M. Whitlock, W. E. Anderson.

Whyte Mfg. Co., Inc.
Booth 202. Exhibit: Injection moldings; vacuum forming of thermoplastics.
Representatives: D. D. Whyte, N. Klein, F. Schlansky.

Wiegand Co., Edwin L.
Booth 940. Exhibit: Chromalox electric heating equipment.
Representatives: R. L. Faber, C. F. Kreiser.

Winner Mfg. Co., Inc.
Booth 943. Exhibit: Reinforced plastics outboard boat, chairs, instrument housings; sandwich panels; honeycomb panels.
Representatives: I. M. Scott, Harry Darby, J. Rosenwald II.

Witco Chemical Co.
Booth 941. Exhibit: Plasticizers; stabilizers; carbon blacks; couplers for polyurethane foams and metallic stearates.
Representatives: Messrs. Vaccarro, Wagner, Prewitt, Robertson, Short, Reid, Grubb.

World Plastex
Booth 128. Exhibit: Extruded components for all industries.
Representatives: E. B. Leimseidor, R. Castelle, M. Naftal, L. Cook.

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and STYRENE, Serving ... THERMOS®, Pouring

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MODERN PLASTICS*

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Editorial

No easy years ahead!

To many who have not been close to the plastics industries during their past three decades of growth, the present volume of plastics sales may appear to have been an easy achievement —and prospective huge future markets likewise easy to gain.

Nothing could be further from the truth!

Not a single solid market for plastics in existence today was eagerly waiting for these materials. It is of record that it took more than two years for electric iron manufacturers to be persuaded to have handles made out of phenolics. It took more than three years to pry open the melamine tableware market even slightly. The high-pressure decorated laminates, now so deservedly popular, were a full decade in reaching even their basic distribution. Polyethylene squeeze bottles, styrene packages, supported vinyl upholstery, even the reinforced plastic fishing rod faced either fearsome competition from vested materials or inertia and misunderstanding in acceptance, all of which had to be overcome before the plastics gained a market.

With a great growth in population, with a faster rate of family formation, with an increase in the standard of living, with needs for all things expanding, it might appear that plastics will just naturally roll on to new high volume in present applications, and in new ones.

It has never happened that way. And plastics progress in the years ahead will be no easier to attain than it has been in the past.

Of special significance is the fact that so many of plastics' upcoming markets are in fields, such as the building field, where codes protect the position of traditional materials and where years of use-tests are required before a new material can become broadly accepted. The same factors concern plastics pipes, foamed plastics of all kinds, and plastics structures. The enlargement of these markets will depend, as in the past, on the plastics products and materials doing each given job better than older materials, or doing it as well with greater economy.

The whole point is that, in plastics, development and sales effort go hand in hand. The bigger the market and the more continuing the application, the greater must be the development and marketing effort. The years ahead for plastics can be years of growth and profit. But they will not be easy.

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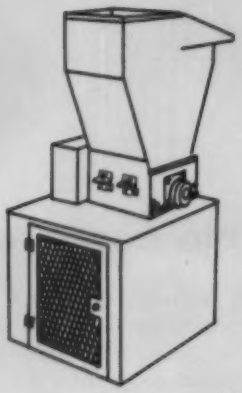

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II.

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architectural or decorative:	$75

Entries must be postmarked not later than SEPTEMBER 30, 1956.

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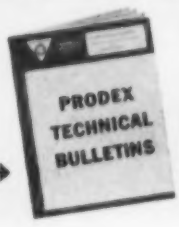

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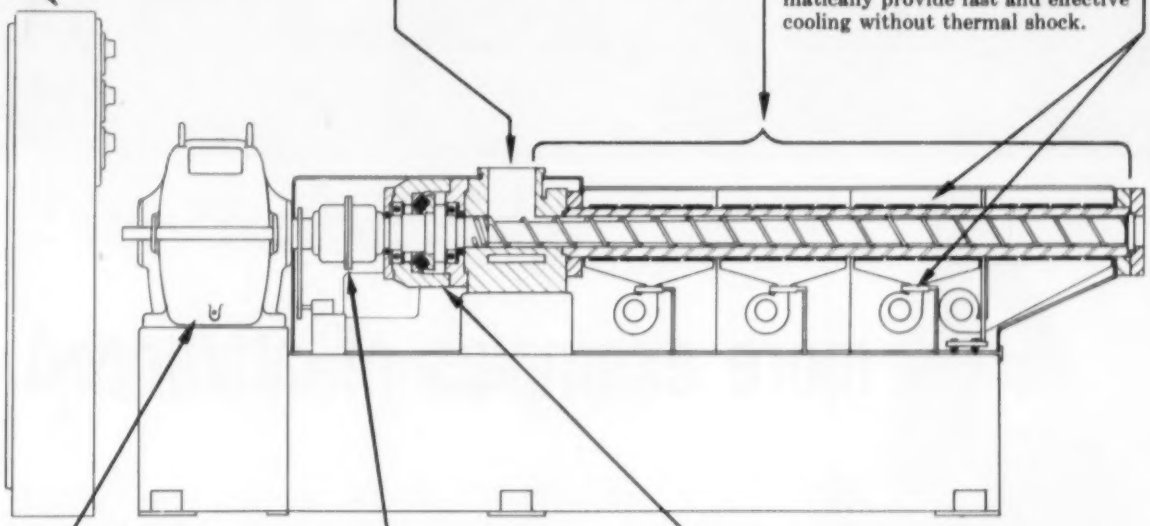

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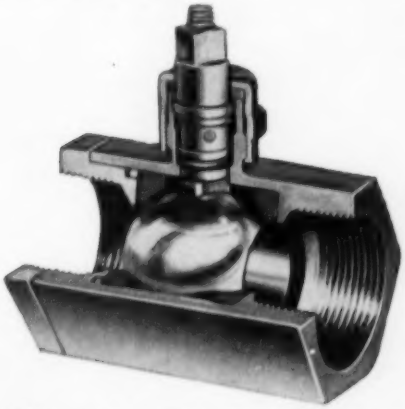

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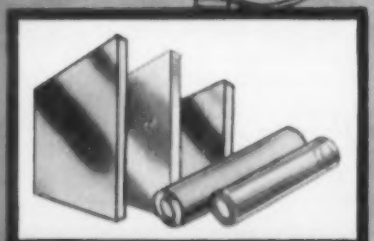

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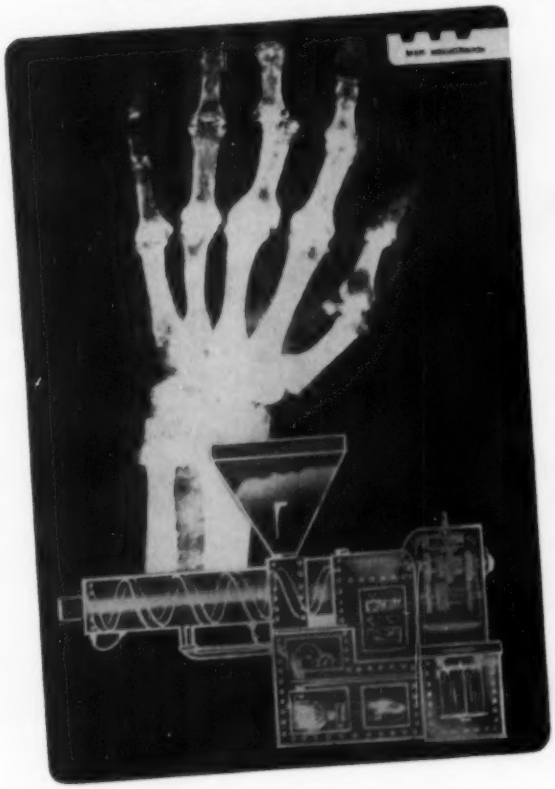

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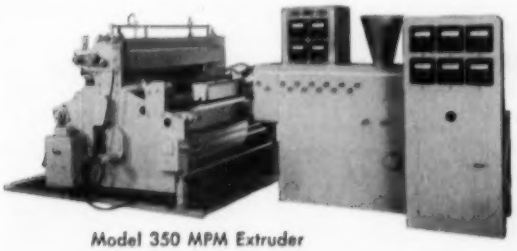

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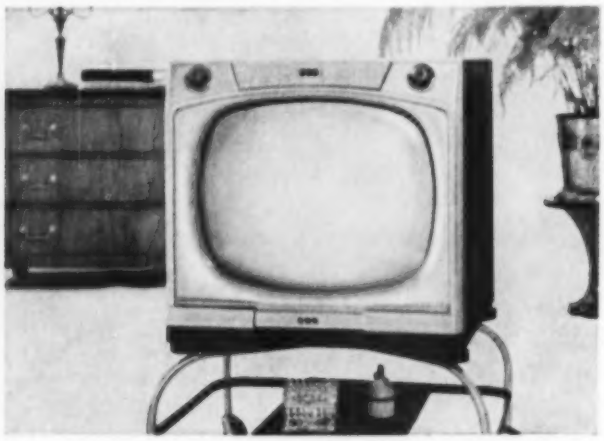
FINISHED BEFORE IT WAS FORMED, this beautiful television cabinet won't chip, crack or craze, defies abuse, abrasion and age. It's made of sheet PLIOVIC laminated to metal.



What do Flowable Gaskets, Flying

WALLS THAT FLY are these attractive panels of calendered PLIO-TUF for aircraft interiors. They are strong, light in weight and highly resistant to impact at low temperatures.

TRUE MEASURE OF QUALITY AND QUANTITY is offered by this pump with liquid end molded of impact- and chemical-resistant PLIO-TUF. Unique construction permits the accurate metering of the most corrosive liquids and slurries.

CRYSTAL-CLEAR SHOWCASES for soft goods are made from tough, transparent film of blown PLIOVIC. It is easily heat-sealed to form dust-free package—resists roughest handling.

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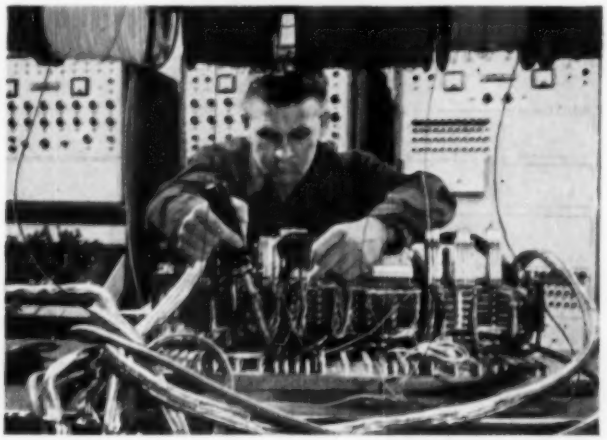
NEW KIND OF CARPET consists of thin sheet of PLIOVIC laminated to heavier rubber sheets. Brightly colored and easy cleaning, it outwears all-rubber mats up to 20 times over.

COLORFUL CLUES for assemblers and users of electronic computers are supplied by wire coverings extruded from PLIOVIC. They provide excellent insulation—are extremely durable.



Walls and Prefinished Cabinets have in Common?

Here are eight products that differ widely in appearance and application. But they do have something in common: Each was made possible by raw materials and services offered by the Plastics Department of the Goodyear Chemical Division.

The materials involved are PLIOVIC and PLIO-TUF. PLIOVIC is the family name for a series of easy processing vinyl resins. PLIO-TUF is the name for a family of high impact styrene resins. They are materials designed to keep pace with the progress constantly being made by the plastics industry.

The services involved range from those of strategically located sales offices and warehouses to well-equipped service laboratories to modern production plants to extensive research facilities. All are staffed by specially trained, experienced personnel to meet the demand for increasingly specialized technical service.

The Plastics Department is new, yet not new. It results from a recent reorganization designed to give customers of the Chemical Division the ultimate in service and quality. It combines experience with the verve and vitality of a new organization well equipped to make its mark in a highly competitive market.

Why not learn how the new Plastics Department can give your present or potential product something in common with those shown here—success! You can, simply by writing and asking for help to: Goodyear, Chemical Division, Dept. R-9422, Akron 16, Ohio.

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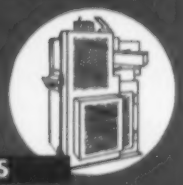

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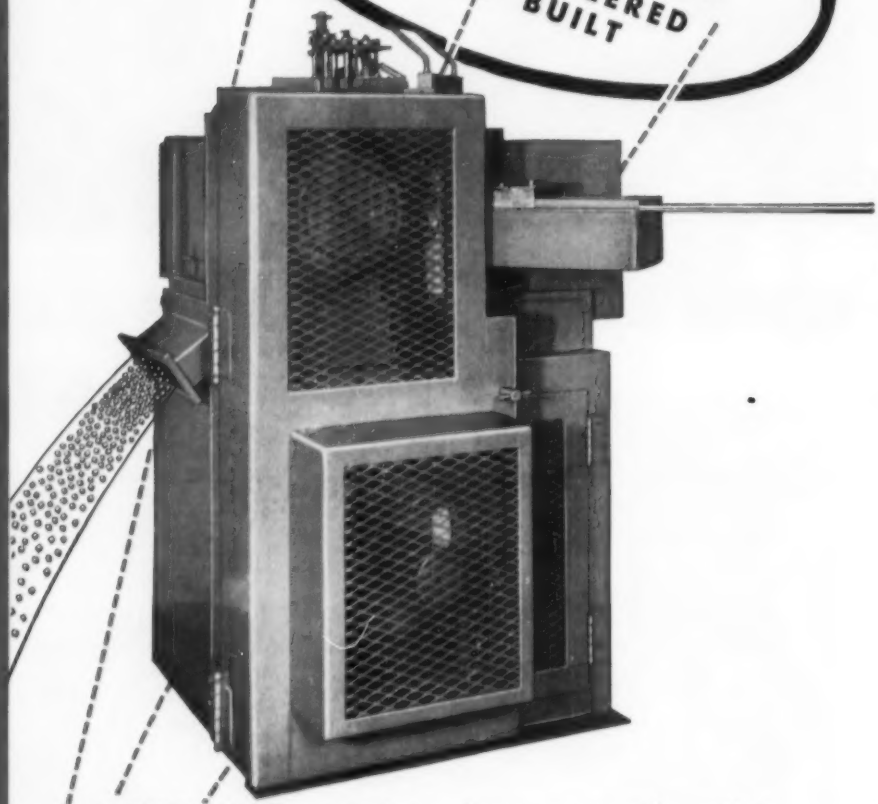

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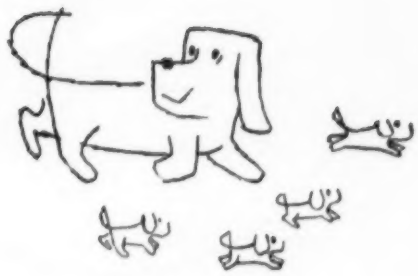
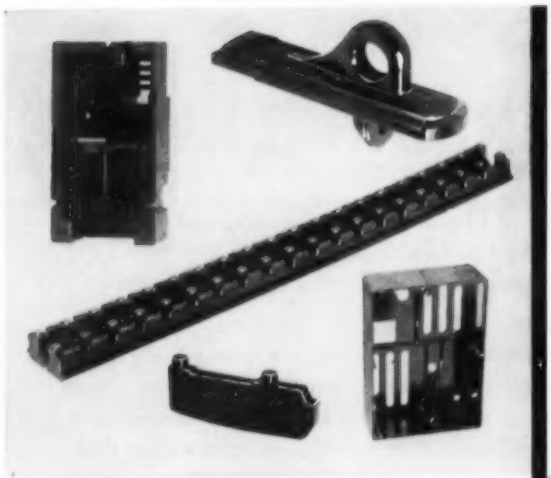
talk about understanding





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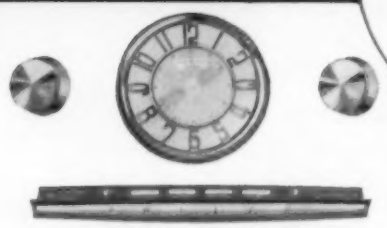
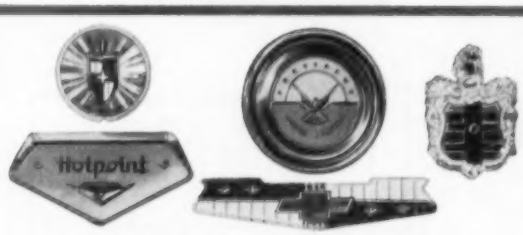
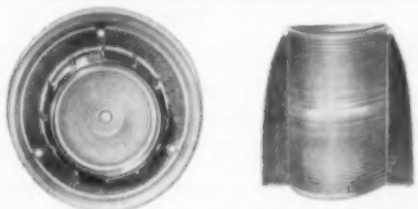


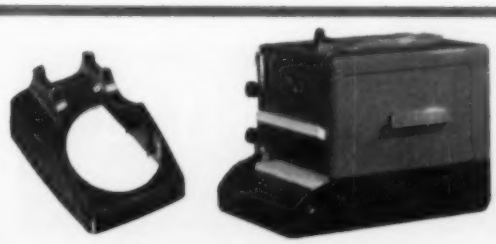
EXTERNAL METALLIZING



THREE DIMENSIONAL PARTS



ERIEFLEX LENSES



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ERIE, pioneer in custom molded plastics, has constantly maintained its leadership in the solution of difficult molding problems, in the development of new molding techniques, and in devising methods for increasing the artistic appeal of plastic products.

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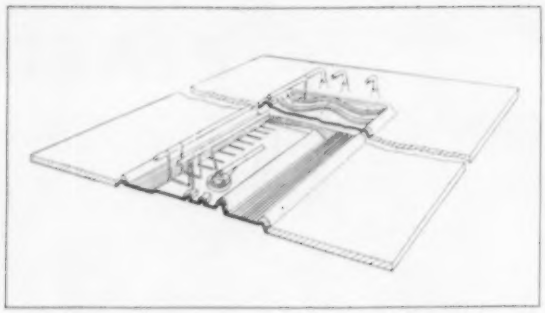
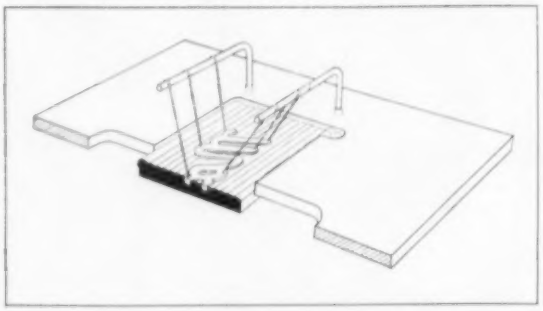
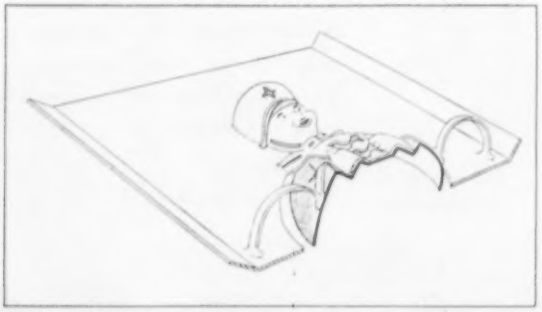


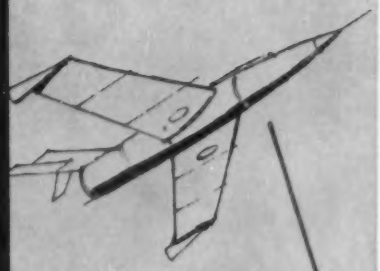
Cap masks . . . Cap masks protect raised detail while the surrounding area is sprayed. The caps (masking elements) are held rigidly in perfect alignment by strong steel wires, thin enough not to interfere with spraying, yet strong enough to withstand normal usage.

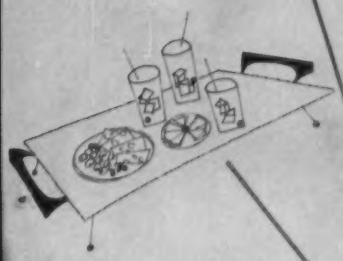


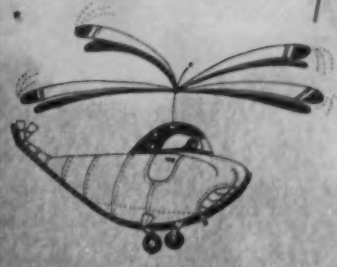
Plug masks . . . Used to plug and shield depressed detail while permitting spraying of surrounding areas. Most back-decorated clear plastic moldings such as horn buttons, emblems, and name plates can be effectively decorated using Fiore masks of this type.



Area masks . . . These carefully constructed masks let the spray touch small raised, depressed, or flat details while surrounding areas are protected. They are widely used in the toy and novelty fields.







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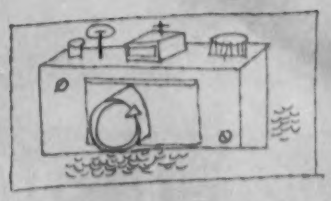

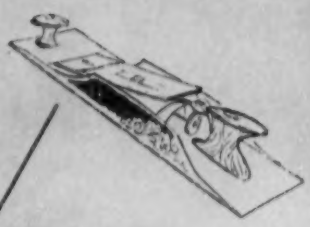

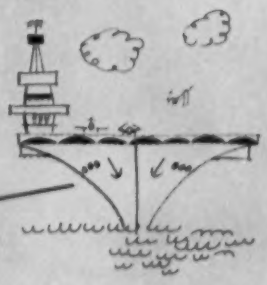

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Hi-fax for better housewares—from mixing bowls
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. . . Hi-fax, a versatile new ethylene polymer to be made
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HERCULES POWDER COMPANY

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All this plus: a richly colorful, lustrous finish. Easy to mold or fabricate by conventional methods.

That's why: People who have seen Hi-fax agree it's the plastic of tomorrow for tomorrow's superior products. Whether you make or design toys, housewares, industrial moldings, sheet and film, pipe, bottles, or electrical insulation, you'll want to learn more about how Hi-fax can improve existing products or help launch new ones.

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See Hi-fax at the Plastics Show ... Booth 830
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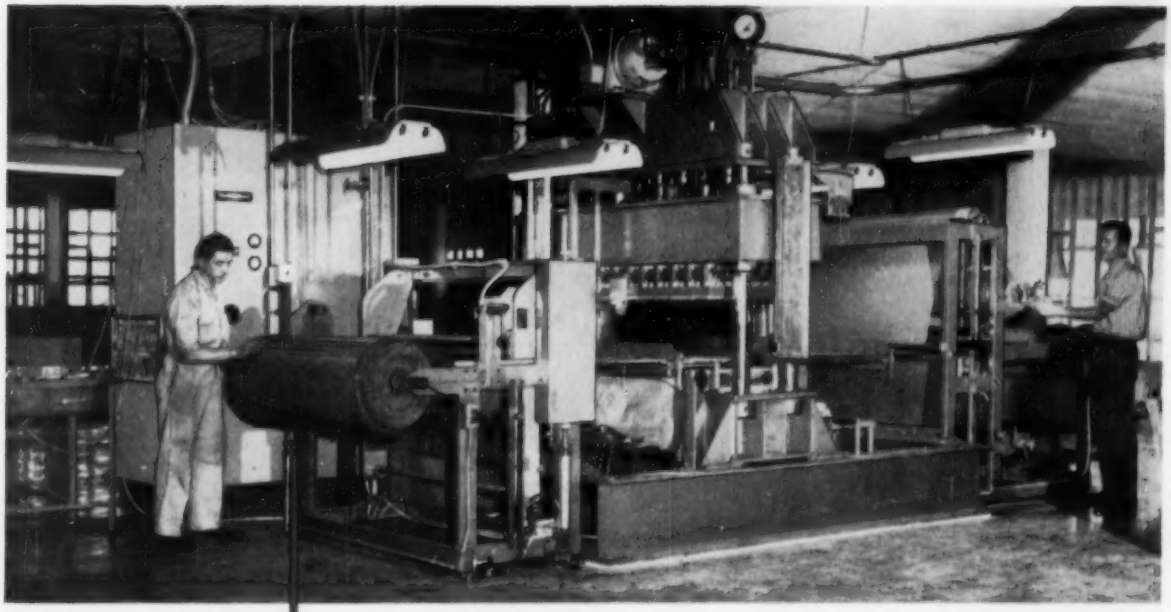
June 11-15



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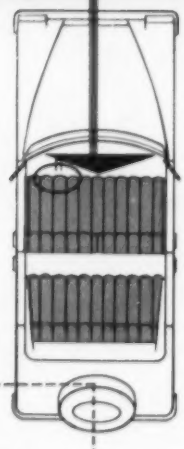

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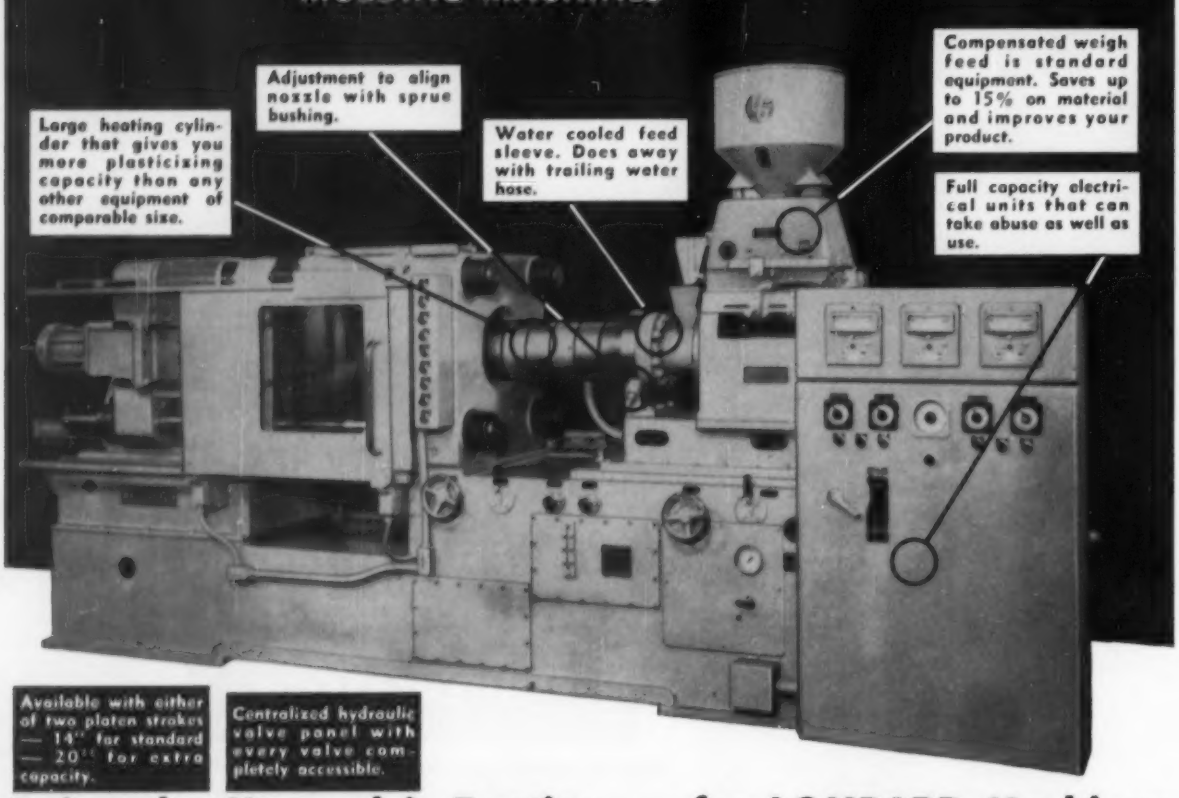
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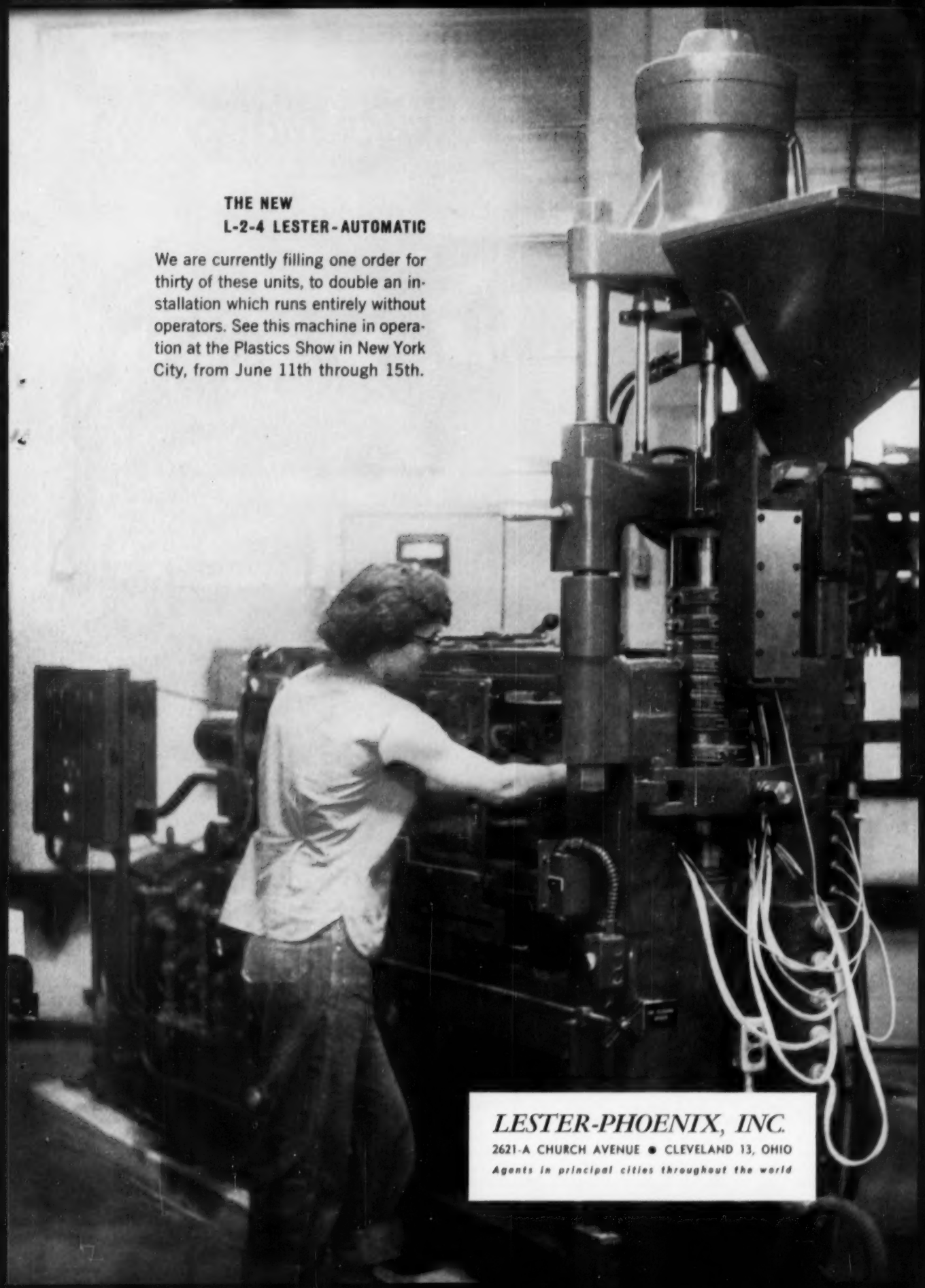

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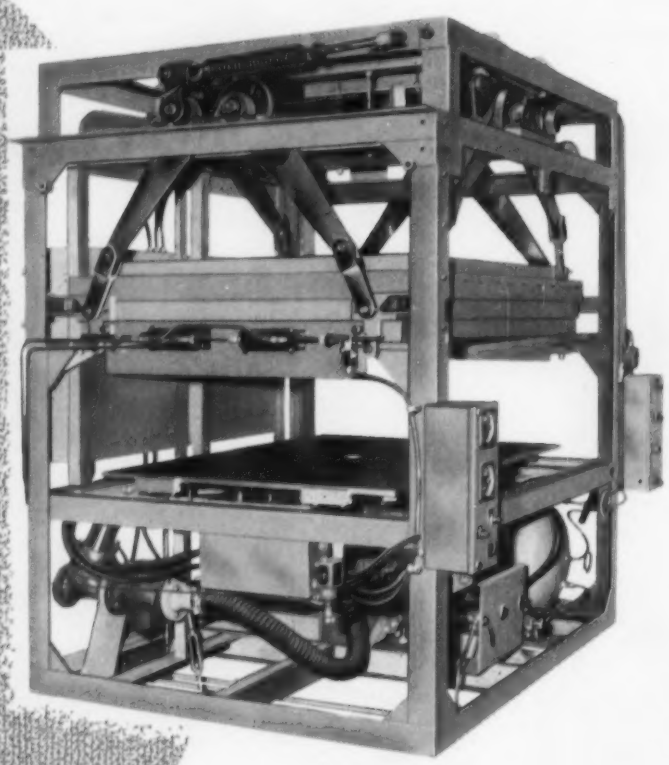

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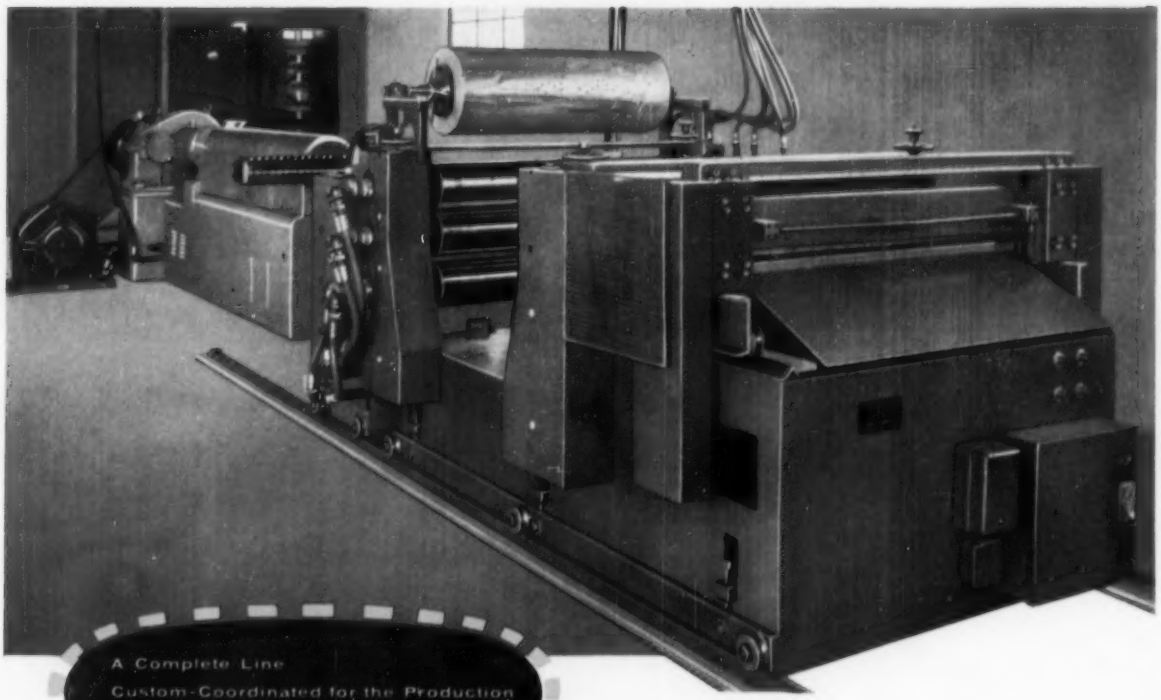

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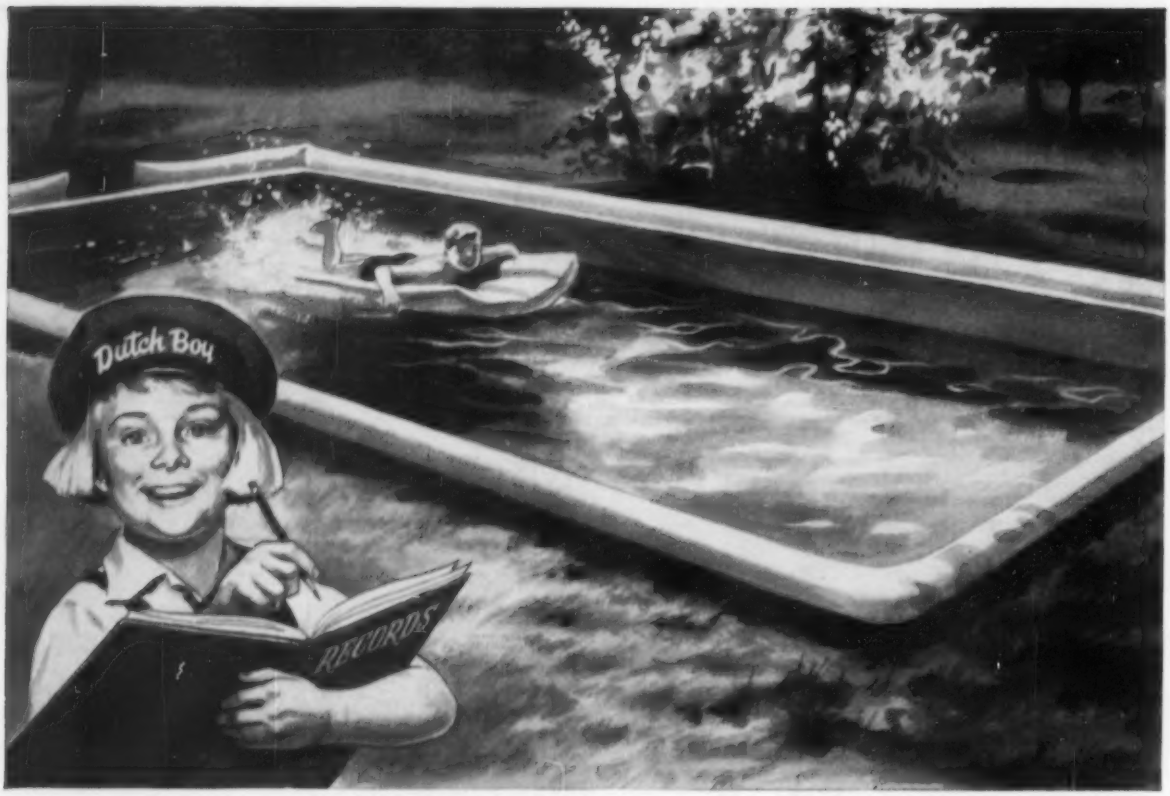

Vinyl pool liner lasts for years! "Dutch Boy" Dyphos reduces weather damage and other types of deterioration to vinyls used for plastic pools.

Sayville tests *prove* "DUTCH BOY" DYPHOS® stabilizes vinyls against weather

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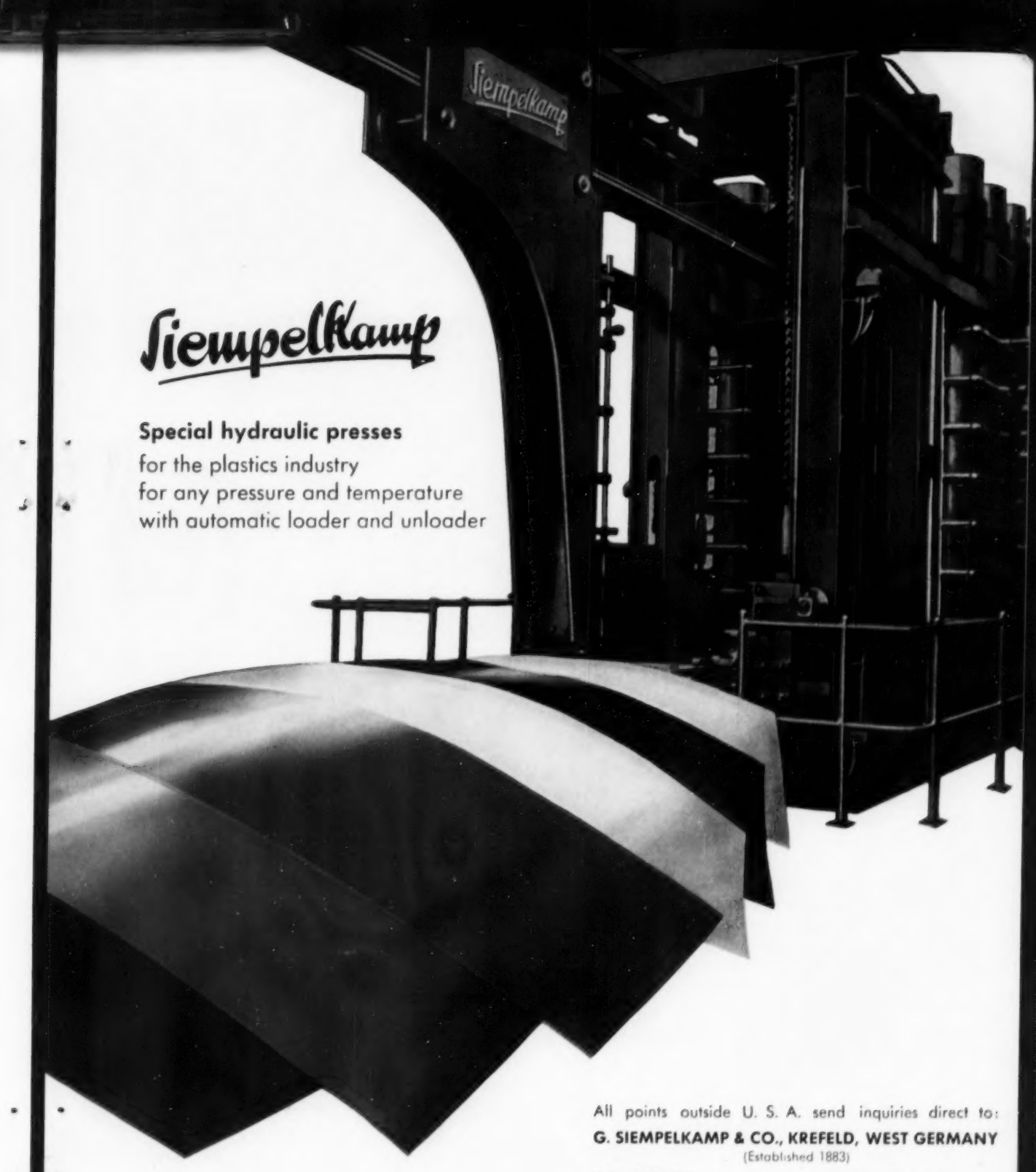

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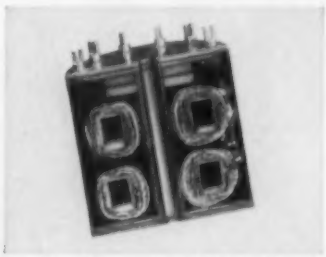
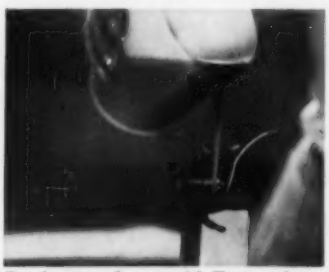
(Epon resins are the epoxy polymers manufactured exclusively by Shell Chemical Corporation.)

Miniature electronic components potted in Epon resin by Freed Transformer Company, Brooklyn, New York.



Section of magnetic amplifier coils embedded in Epon resin by Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.



Potting transformer with Epon resin at PCA Electronics, Inc., Santa Monica, California.

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The Plastiscope

News and interpretations of the news By R. L. Van Boskirk

Section 1

Impressions in plastics at Packaging Show. The importance and growth of thermoplastics in packaging is so huge that it seems unfair to name only a few outstanding impressions when there were a dozen or more standouts at the recent Atlantic City exposition. Each observer would probably name them in different order, but to this reporter some of the unusually significant trends were: the continuing increased ratio of growth for polyethylene and the cellulosics in packaging; the intense rivalry between nearly all types of film for domination of the wrapper market for processed meats; the disappearance of double-layer transparent film bags in favor of a single layer, due in part to improved printing technique; and the impressive bid being made by thin-walled polystyrene in both molded and vacuum formed containers for a major portion of the packaging market. (See also page 428.)

More news about cellulose plastics shoe heels. The new women's shoe heel market discussed in the May issue of MODERN PLASTICS is arousing unusual attention as a big volume potential for plastics. Analysts have been busy as bees trying to estimate the possibilities. A recent joint S.P.I.-S.P.E. meeting in Boston was devoted entirely to plastics in shoes, with heels particularly in the limelight. As a result of all this interest, Celanese has come up with some interesting details on the part that cellulosics are playing in this market. Their spokesmen say that the wood heel industry is now using cellulose acetate but is also evaluating butyrate (Tenite) and cellulose propionate (Forticel) and that wood heel makers are forming "combines" to purchase molds. More than 3000 styles of heel seats and shapes are required, each using a different mold. Most common is a 10-cavity mold using 1 lb. of material per shot. One New England combine is making enough heels to consume 4600 lb. a day, six days a week. Total possible volume for cellulosics is estimated at over 4 million lb. a year.

Further expansion of shoe heel market. The cellulosic shoe heel began as a replacement for rock maple spike heels which, because of breakage, required a metal insert. That insert often made trouble for shoe manufacturers or cobblers because heels would frequently split when shoe nails were driven against the metal. Plastics heels eliminate that problem. Furthermore, it is claimed that prices of the plastics heels closely approximate those of wood heels. Success in the spike heel has now led shoe manufacturers to try plastics for Cubans, Louis', and flats. Plastics flat heels that are cored out to make them comparable in weight to wood heels offer a complete new market. Investigation is also under way to determine practicality of plastics shoe heels for men.

What do signs mean to plastics? Any visitor to the recent Point-of-Purchase Advertising Institute Show where the latest window and in-store displays were on exhibit could quickly perceive the overwhelming invasion of this field by plastics. Methacrylate and unplasticized vinyl sheet are virtually old-timers in this field but still growing—vinyl combined with cardboard has been found particularly useful and lithographers like it because of its exceptional affinity for ink. But sign makers who need larger sheets than they can get in vinyl turn to butyrate and impact styrene for that purpose. One butyrate sign on display was 6 by 4 feet. Styrene-type sheet of all sizes is now moving in big volume—Disney animal ads and

*Reg. U.S. Pat. Off.

wood-finish display racks are examples. Interesting property is that styrene impact sheet loses milky appearance when back lighted. It also meets fabricators' desire for shatterproof products. Further evidence of plastics trend was the election of Stanley Wessel of Stanley Wessel Co. as president of the Institute. He is one of the earliest pioneers in the development of formed plastics sheet for display purposes.

Color in motion. Dynalite is the tradename of a new methacrylate sign that gives the impression of constantly moving color to the viewer. Optical lenses are pressed or molded into the methacrylate surface and correlated with lines in a moving Mylar screen set behind the methacrylate sheet. The screen is oscillated with a small motor. The producer of the sign is Tel-A-Sign, Inc., Chicago, which is also producing a butyrate sign with embossed letters that are made to glow like neon signs. Other details on this growing sign market were given in MODERN PLASTICS, May 1956, p. 110.

Display transparencies. A cabinet containing a deftly arranged combination of 51 plastic color slides that can be shifted behind a plastic transparency to show over 4000 possible color combinations for automobiles is being marketed by Wm. Melish Harris to Buick automobile dealers. Still another Harris product for auto dealers is a 36- by 54-in. color spectacular which can be viewed from either side and sells in quantity to a dealer organization for approximately $5 a picture. According to Mr. Harris, a conventional photographic spectacular of this type would cost over $200 and would require artificial lighting; the Harris transparencies are not dependent upon artificial lighting, although of course it makes them more brilliant. These transparencies are sunfast and won't fade when exposed to light. The secret of the Harris process is a special coating on the plastics sheet. Originally a vinyl chloride unplasticized sheet was used by Harris, but it is now possible to use one of several materials, depending upon the use for which the transparency is intended.

Melamine price reduction. A price reduction of 3¢ a lb. for melamine crystals, which now makes it 30¢ a lb. for car- or truck-load quantities, has been announced by American Cyanamid Co. At the same time, an expansion plan to install 20 million lb. more capacity at the company's Wallingford, Conn., plant was announced as part of a larger expansion program which has already resulted in a 20% increase in the melamine output at Willow Island, W. Va., and construction of added facilities at Welland, Ont., which will increase that plant's output of dicyandiamide by 10 percent. The latter is a raw material used in melamine manufacture.

Monomethyl styrene. The first phase of the expansion plan for American Cyanamid's Fortier plant near New Orleans is a new monomethyl styrene plant which is now completed. The new material will be used with other chemicals for production of thermoplastic molding compounds that have high heat resistance. Additional expansions in the evaluation stage include plans for large-scale production of acrylamide with potentially wide industrial uses. Plans are also completed for doubling capacity to produce acrylonitrile, of which Cyanamid is already the nation's largest producer.

Color for phenolic. In the article on Plastics Materials in the Years Ahead, starting on p. 155 of this issue, the statement is made that "there are always rumblings about a colored phenolic." A new development now takes these rumblings out of the rumor class. It's not really colored phenolic but a new epoxy-based enamel in almost any color, including metallic, which can be applied to phenolics at a cost of approximately 1¢ per sq. ft.; it is arousing considerable excitement among phenolic molders. It is being used on such items as radio cabinets, steam iron handles, base plates for coffee makers, control switches on electric blankets, and various other appliances, and is being tested for washing machine agitators. It is believed to be one of the most unusual of enamels, for it can be successfully applied to nearly all materials. Thus it becomes possible to use one base enamel and obtain a perfect match for everything in an

assembly whether it be glass, zinc, wood, copper, or some other thermoset. Colors can be changed by simply changing the mixture in a spray gun so that, for example, 300 units of a finished product may be supplied in red, 200 in blue, and 400 in gray, or in whatever other proportions may be desired. It is also being used on urea radio cabinets to eliminate rejects caused by black spots or flaws. It is named Rexclad "R," and is supplied by Rexton Finishes, Inc., Irvington, N. J.

W. R. Grace & Co. merger with Cosden. Executives of W. R. Grace & Co. and Cosden Petroleum Corp. have agreed on a merger, but it will probably be late June or July before completion of the transaction. If the deal is completed, Cosden will be the eighth division under Hugh S. Ferguson, executive vice president for the chemical group of Grace. Cosden, located at Big Spring, Texas, recently announced a new 20 million-lb. a year styrene plant where the chemical will be produced by a new method which eliminates a costly step now used by other producers. At this time Grace officials are unwilling to reveal any plans they may have for that styrene operation insofar as it relates to plastics. The proposed purchase of Cosden is obviously a step toward obtaining a source of petrochemicals similar to the tie-up now existing in various other chemical and petroleum company joint ventures. The other Grace chemical divisions are Dewey & Almy, Dewey & Almy Overseas Div., Cryovac, Davidson, Grace Chemical Research & Development, Grace Chemical in Memphis where urea and ammonia are produced, Polymer Chemicals Div. with headquarters in Clifton, N. J., and operations plant at Baton Rouge, La., where the Grex polyolefin resin will be produced.

Clarity and impact. Monsanto Chemical Co. is marketing a new polystyrene formulation called Lustrex Hi-Test 88B 1000-126 in which better clarity is successfully combined with high impact. The new material is specially suggested for food packaging. Monsanto's tests are reported to indicate that the opacity of the new material is 50% less than that of its standard high-impact material, but that strength properties have not been sacrificed.

More polystyrene capacity. Foster Grant has doubled the capacity of its Louisiana operation where styrene monomer and polymer are produced. The polymer capacity has been increased 50%, but the company has never stated how much of the original capacity of the plant was devoted to polymer production. New high-flow and high-impact materials will be added to the company's former general-purpose polystyrene material. Foster Grant sold stock to interests outside company management for the first time in its history to help finance the $1,665,000 expansion of its monomer plant. A total of $3,490,000 was raised through privately-placed sinking fund notes and convertible stock. Of that amount, $1,825,000 was used to refund outstanding institutional obligation.

Expandable polystyrene. United Cork Companies, Kearny, N. J., has obtained a license to use the patents owned by Badische Anilin- & Soda-Fabrik of Germany for production of expandable polystyrene in the U. S. It will be marketed in the U. S. under the tradename Uni-Crest. Company literature states that when the material is molded according to the processes and techniques developed by European chemists, it develops a smooth, tough surface that can be coated with a variety of textures and colors. More than $1 million will be spent on a molding plant in Kearny and a raw material or "bead" plant in South Brunswick, N. J. Additional plans call for two more molding plants—one in the midwest and another on the West Coast—to be completed in 1957. The Kearny production will be available this year in molded slab, brick, or block form in lengths up to 12 ft., widths up to 4 ft., and thicknesses up to 8 inches. A Uni-Crest Div. of United Cork has been set up with Wm. E. Stewart as eastern sales manager at Kearny, N. J., and Hugo Stowasser as midwestern sales manager in Chicago.

Resins for shell molding. Growing importance and variety of phenolic resins for shell molding has been emphasized by Monsanto Chemical Co.'s announcement of four new

foundry resins for that purpose. The company asserts that the new type resins increase the number of uses to which shell molding can be applied and make older operations more efficient. One of the new formulations is a liquid resin for hot coating—the others are for cold coating; one is a liquid and the other two are powders.

New plant for polyurethane foam. Hewitt-Robins, Inc. will build a 2 million-lb. capacity plant in Franklin, N. J., to manufacture flexible urethane foam. A temporary plant is currently operating at Long Valley, N. J., near Franklin. Completion is scheduled for September 1, 1956. This is the company's ninth plant, including one in South Africa, where foam rubber, conveyor belting, and other products, most of which are dependent upon rubber, are being manufactured.

Vinyl in bottle cap. A new vinyl cap liner has been developed for use in a new aluminum cap for catsup bottles. A white vinyl compound is extruded and die cut into proper size disks; these are coated with adhesive on one side and automatically inserted into the caps before the latter are threaded. The vinyl liner gives a thinner seal, slides easily into place, doesn't turn black, and can be easily cleaned. The new cap is expected to find many uses other than for catsup.

Masland enters rigid vinyl field. Masland Duraleather Co. has installed new equipment at the company's main plant in Philadelphia to produce rigid vinyl sheets up to 54 in. wide and 102 in. long. Various thicknesses can be achieved, and all materials will be laminated and stress relieved. The new material will be added to Masland's regular line of calendered elastomeric vinyl, of which the company is a pioneer producer.

Dynel upgrades fibrous glass laminates. Dynel overlays for fibrous glass laminates are reported to improve weathering, to reduce shrinkage problems, to give highly improved wetting properties, and to be low in cost, according to tests announced by Carbide and Carbon Chemicals Co., the producer of Dynel. A reinforced plastics fabricator could hardly ask for more important improvements because weathering, shrinkage, and wetting are properties which are frequent trouble-makers for him. Dynel, a copolymer of vinyl chloride and acrylonitrile, is available in woven or non-woven fabric in suitable weights for overlays. A 6-oz./sq. yd. fabric or lighter is generally used. A Dynel surface not only improves abrasion resistance of the laminate, but improves resistance to chemicals and water damage. It will help to minimize the frequently encountered 10% resin shrinkage. The wetting quality is said to be so thorough that overlay fabrics actually become transparent when resin is poured on them.

Polymer meeting at Notre Dame. A significant meeting for the plastics and chemical industries will be held at the University of Notre Dame July 16-17 when six internationally recognized authorities on polymer chemistry will appear at a two-day conference. They are: Prof. Guilio Natta, Italy; Prof. Chas. Sadron, France; Dr. W. B. Reynolds, Phillips Petroleum; Dr. Arthur P. Lien, Standard Oil of Indiana; Prof. Herman Mark, Brooklyn Polytechnic Institute; and Dr. G. F. D'Alelio, Notre Dame, who will serve as chairman. The symposium will explore the potential industrial importance of the new hydrocarbon polymers such as the highly crystalline polyethylenes and other isotactic or related polymers. The meeting is to be sponsored by W. R. Grace Chemical Research & Development Co.

National S.P.I. Conference 1957. The board of directors of S.P.I. has approved a West Coast Plastics Exposition in the spring of 1957. The National S.P.I. Conference for 1957 will be held in Los Angeles at the same time as the Exposition.

For additional and more detailed news see Section 2, starting on p. 423.

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New York City, June 11-15

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Are you presently using cast acrylic sheets 1/16" to 3" thick?
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—IT'S LOWER IN COST!

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Apace with each day's increasing demands, we warehouse "in depth" and for immediate delivery, the industry's largest and most complete range of plastic materials . . . All types—sizes—thicknesses. All colors —and all formulations quality-certified for uniformity!

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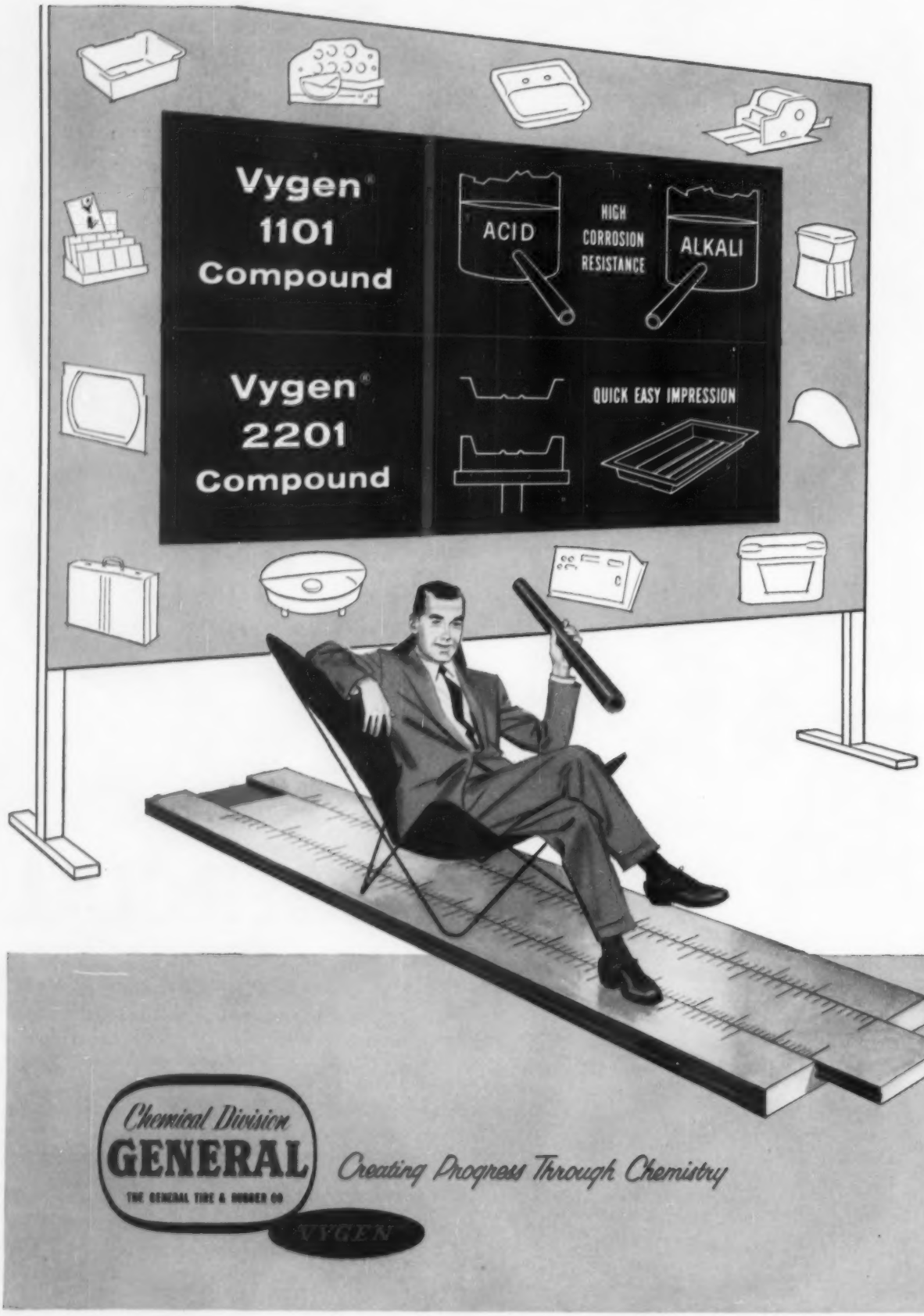
Vygen®
1101
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Rigid P. V. C. Compounds

These two new Vygen rigid compounds offer easy expansion into new and better products and markets. As with Vygen-110, they are subjected to General's rigorous testing conditions and production controls. These two easy processing compounds give you ready access to the growing market potential in extruded PVC pipe and post-formed PVC products.

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VYGEN 1101 COMPOUND

A rigid Type I PVC compound designed specifically for extrusion. This compound comes ready for the extruder and offers the perfect balance between optimum chemical resistance and easy processing. Vygen 1101 compound can be made in a number of colors, and provides excellent dimensional stability in the finished product.

VYGEN 2201 COMPOUND

A rigid PVC compound which is easily processed on existing calendering equipment. Can be pigmented for light colors including white. Has inherent flame resistance, high flexural modulus, high hardness. Calendered sheet is excellent for deep drawing or vacuum forming applications.

write • call • wire • or walk in!

Chemical Division B
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Please send samples and literature on the compounds and resins checked below.

☐ VYGEN-110 Polyvinyl chloride resin
☐ Vygen-1101 Compound Rigid PVC unmodified
☐ Vygen-2201 Compound Rigid PVC (calendering)

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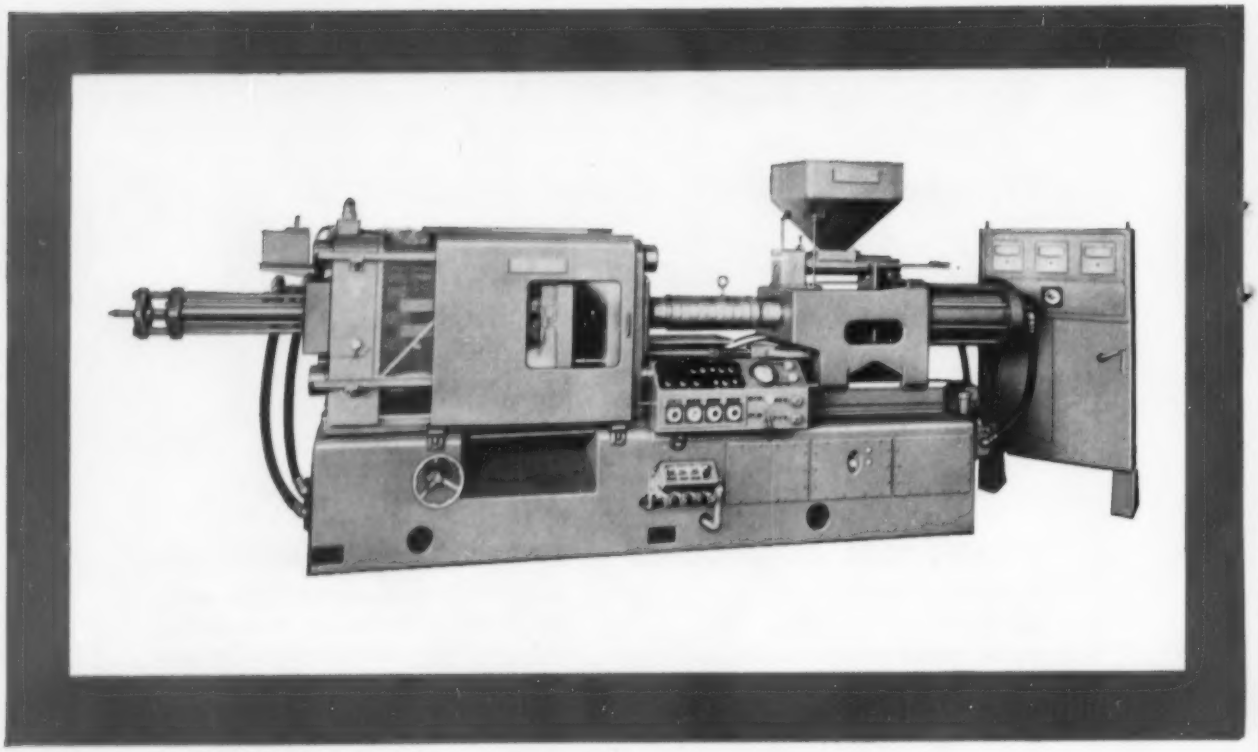
STREET_____ CITY_____ STATE_____

B

Don't Miss These REED

A New 8 oz. Injection Machine...Plus



Once again, REED engineering leadership points the way. Now, as another result of its continuing program of engineering research and development, Reed-Prentice presents two brand new machines.

This new 275T—8/10 oz. injection molding machine has been designed to replace the 10D—8 oz. REED, known till this time as the 'workhorse' of the industry. In the 275T, you will find all the rugged dependability that made the 10D-8 so widely accepted. But more than that, you'll see 11 big, new features . . . features that mean higher speeds, larger plasticizing capacity, greater versatility, and easier, more economical operation.

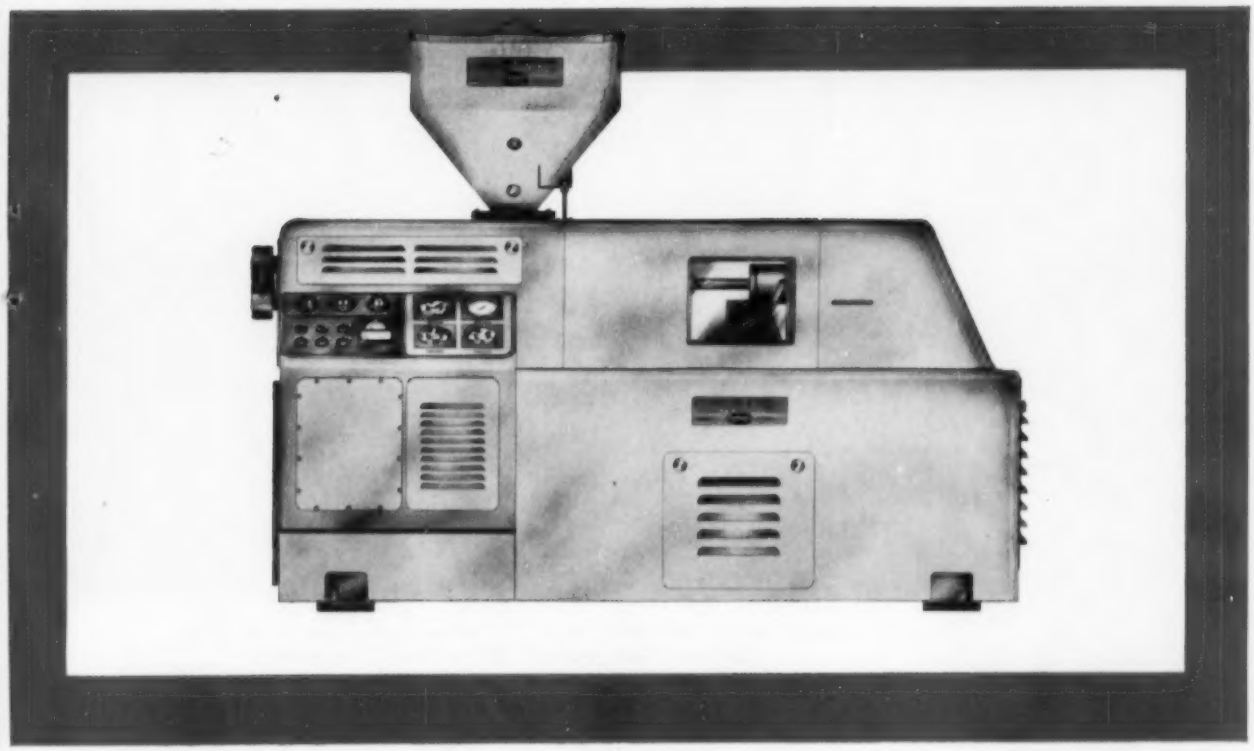
See this latest REED . . . one of the full line of injection machines available in 4, 8, 12, 16, 20 and 32 oz. capacities.

For the industry's latest engineering advances, visit

REED-PRENTICE, Booths 1018 and 1026, at the 1956 Plastics Show.

INTRODUCTIONS At The Show...

The Revolutionary New AUTOFLOW Extruder!



In the ***Autoflow,*** Reed-Prentice introduces the greatest advance made in extrusion in the last 20 years. This machine operates on an entirely new principle. It gives you far greater output in pounds per horsepower per hour, plus outstanding ability to color and compound. One screw type handles all materials. The ***Autoflow*** has precise speed and pressure control, delivers a more even flow of higher quality production. It is especially suited to heat-sensitive materials.

You can see both a production model and a bench model of the ***Autoflow*** in operation at the REED booth. Engineers will be in attendance to demonstrate the features of this amazing new extruder and answer your questions.

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Affiliate of **PACKAGE** MACHINERY COMPANY

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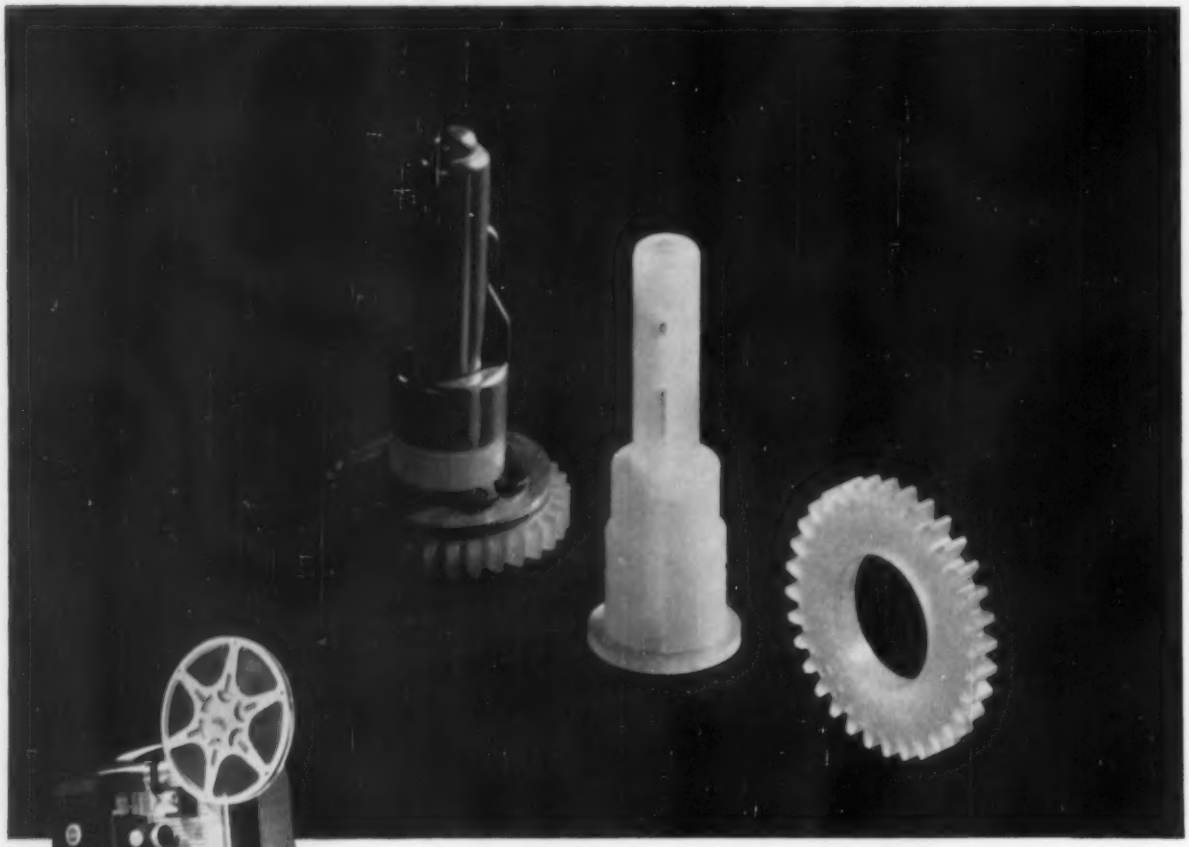
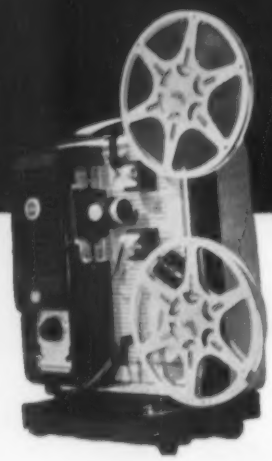
BRANCH OFFICES: NEW YORK • CLEVELAND • CHICAGO • BUFFALO • DAYTON • KANSAS CITY • LOS ANGELES **REPRESENTATIVE:** MINNEAPOLIS—CHAS. W. STONE CO.





Here are 2 of more than 30 Quinn-Berry parts used in Eastman Cine-Kodak Showtime 8 Projector.

AT QUINN-BERRY THE UNUSUAL IS ROUTINE

In one unusual application, the molded nylon gear and spindle shown above—along with seven sheet metal and two steel parts—form the reel-spindle assembly. Using two of these assemblies on each projector to mount the film reels, Kodak has effected a considerable saving compared to the cost of conventional machining methods.

Quinn-Berry molded nylon parts provide a high degree of uniformity . . . have long-wearing characteristics . . . require little or no lubrication. For example, the gear in the reel-spindle assembly, although subject to friction when the projector is in operation, requires no lubrication.

At Quinn-Berry, every job is engineered, step by step, from die design to finished product under one responsibility and one control . . . the reason why "The Unusual is Routine at Quinn-Berry".

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MOLDERS OF ALL TYPES OF THERMOPLASTICS

INTRODUCING the ultimate in low cost, high flex modulus

Bigelow Lamimat*

ANNOUNCING — one of the most important innovations in the whole field of plastics . . . a superb new reinforcing material developed by the *leader* in fiber blending — Bigelow. It provides the answer to the major problem of molders and laminators of reinforced plastics — how to achieve high flexural modulus at low cost with light weight. The answer — in a word is — LAMIMAT.

BIGELOW
Fiber Glass Products

What Lamimat is — A drapeable, uniform, lightweight mat with a blended organic-glass core and an all-glass face.

What Lamimat does — Enables you to build *thicker sections with high flexural modulus and considerably less weight* than when using mats of all-glass fibers.

How Lamimat saves you money —

1. *More Bulk for the Money.* Pound for pound, Lamimat provides more necessary volume than do all-glass mats . . . but costs no more!

2. *You Use Less Material.* Because Lamimat is lighter and bulkier, you use less poundage of reinforcing material and less resin to achieve the same thickness as when molding with all-glass mats.

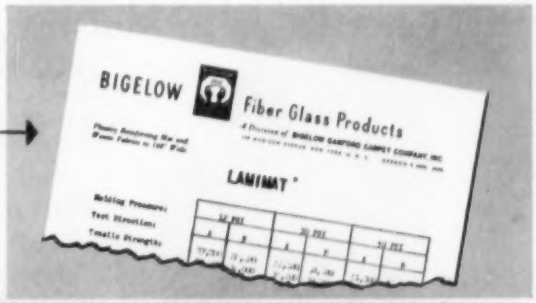
3. *Puts Strength Only Where You Need It.* Allows you to design more efficiently, without using wasteful excess material or unnecessary strength in other areas.

4. *Cuts Down Fabricating Costs.* Because Lamimat can be fabricated in thicker sections at the start, it eliminates necessity for costly processing or adding layer on layer to achieve thickness.

And if lightness is a strong selling point in your product — Lamimat's low specific gravity gives you a laminate that is light — yet strong.

Whatever you're molding, Lamimat can simplify your job, solve production problems to your complete satisfaction. **Send for technical data sheet and free samples.** →

See us in Booth 942 — 7th National Plastics Exposition, New Coliseum, N. Y. C., June 11-15



* A Bigelow Trademark

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Division of
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THERMOLATOR

REG. U.S. PAT. OFF.

MOLD TEMPERATURE CONTROL of MATCHLESS VERSATILITY

In Streamlined Modern Installations:

MODEL "H" AUTOMATIC THERMOLATOR with CONTROLS INTEGRATED IN MASTER INSTRUMENT CONTROL PANEL *(Left)*—THERMOLATOR controls are built into master control panel by the instrument manufacturer. All press and mold controls in a central location for time-saving supervision. THERMOLATOR Operating Unit located anywhere.

MODEL "H" AUTOMATIC THERMOLATOR with SEPARATE CONTROL PANEL *(Right)*— Designed for location alongside existing press control panel, with easy-to-read Pyrometer Scales and Pilot Lights for instant check of operating conditions.

Manufactured under U.S. Pat. 2,632,088 to JIC standards.

For Use With Multiple Molds:

Model C-3 *(Left)*—With individual controls, tanks and pumps, for 3 mold sections. An adaptation of Model C THERMOLATOR, to order.

For Regular Molds:

Model C—The original THERMOLATOR with semi-automatic controls maintaining mold temperatures within a range of ½°-F.

FOR INFORMATION WRITE TO . . .

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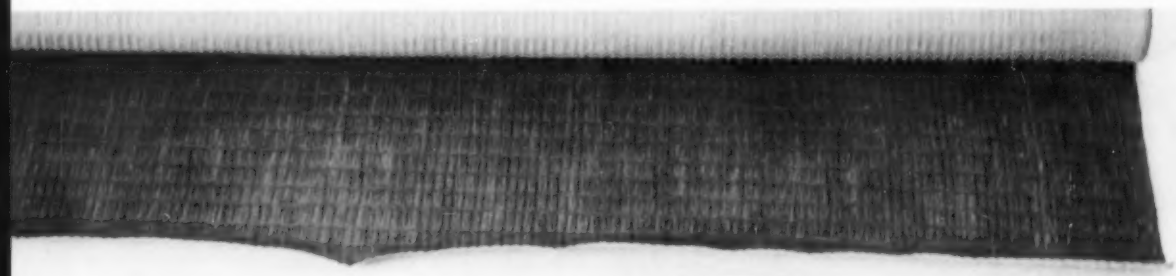
Product-Building for Profits with Monsanto Plasticizers

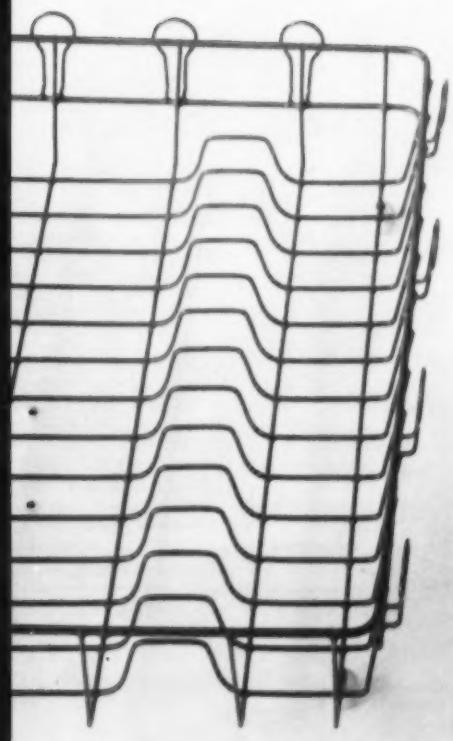
Your choice of the right plasticizer systems reduces your formulating and processing costs, and helps you "build" finished products with more profit to you.

Monsanto is America's most diversified manufacturer of primary and secondary plasticizers, and an outstanding source for sound technical information—formulating know-how not only for vinyls, but also cellulosics, styrenes, phenolics, melamines, ureas, epoxies.

Call on Monsanto for one-stop raw material service—and expert technical guidance from America's most experienced manufacturer of plasticizers. In your interest, Monsanto offers a . . .

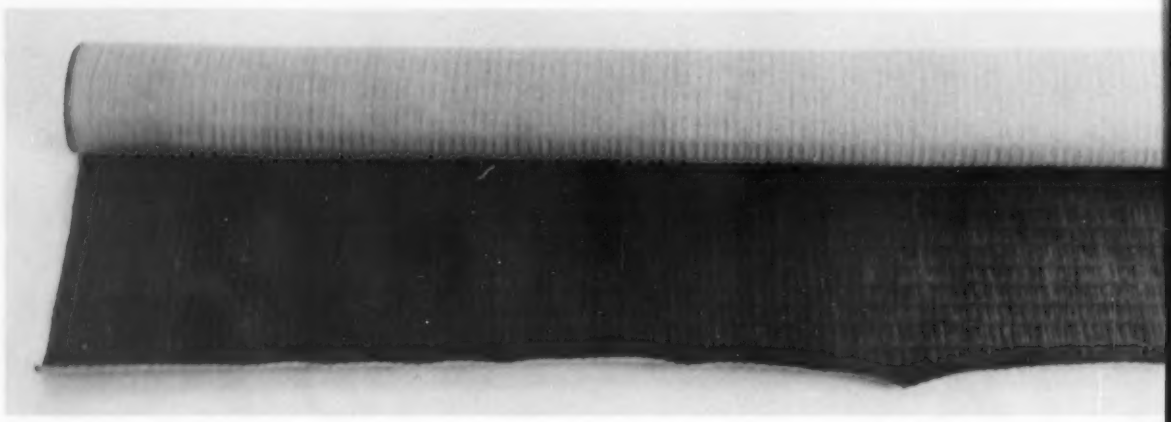
"Plasticizers Council Service". . . For specific recommendations on plasticizer systems to increase your processing efficiency or to improve your products—contact your Monsanto representative. He can offer you "Plasticizers Council Service" on new products—or on established formulations—a service created by Monsanto to help you solve formulating problems quickly and profitably.





If your business is . . . Vinyl Dispersions and Solutions

You can build product quality, reduce costs of...



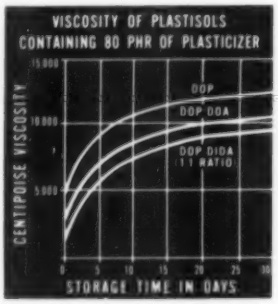
. . . Coated Fabric Upholstery

Resistance to Staining and Abrasion . . . Monsanto Santicizer 160, alone or in blends with other plasticizers, imparts excellent resistance to fats, greases, oils, solvents, and common household chemicals. Most important, Santicizer 160 substantially lengthens the service life of coated fabrics by increasing resistance to abrasion. Test results (below) show the superior abrasion resistance of a vinyl composition (40% plasticizer, 60% Opalon 300) plasticized with Santicizer 160, compared with the inferior abrasion resistance of the same composition plasticized with standard dioctyl phthalate. (Test: Taber Abraser with 1000 gram load using H-22 wheels.)

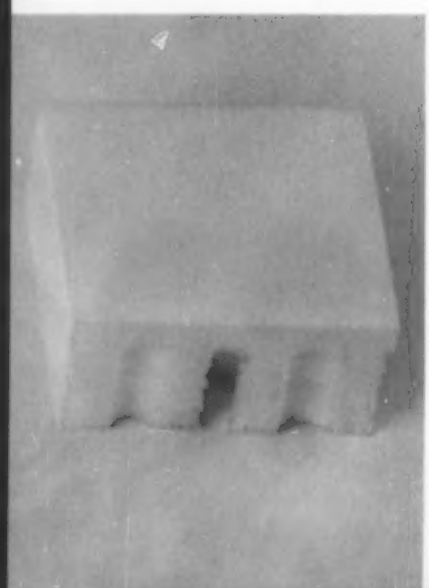
Plasticized with	*Loss in weight per 1000 cycles*
Santicizer 160	105 milligrams
Dioctyl phthalate	158 milligrams

Flame Resistance . . . Monsanto Santicizer 141, an outstanding primary plasticizer for plastisols, imparts superior flame retardance, light stability, and resistance to weathering. Santicizer 141 reduces formulating costs when used to replace phosphate esters or addition of antimony oxide.

Longer Plastisol Shelf Life . . . Monsanto DIDA and DIDP lengthen shelf life by retarding "thickening" of plastisol formulations. This reduces costs by preventing premature "gelling", and waste of raw materials before they can be used. The graph (below) shows how Monsanto DIDA slows viscosity build-up in a typical plastisol plasticized with (1) DOP only, (2) equal parts of DOP and DOA, and (3) equal parts of DOP and Monsanto DIDP.



The volatility of Monsanto DIDA is only about one-third that of dioctyl adipate. It offers the excellent low-temperature flex of the adipates, yet eliminates the high volatility of dioctyl adipate—and can be used to replace most higher-cost, low-temperature plasticizers.



. . . Foam Vinyls

Foam Manufacturers can select the optimum plasticizing system—balancing cost, processing traits, and end-product properties—from the extremely versatile line of Monsanto phthalates, adipates, phosphates, phthalyl glycolates, and specialty plasticizers. Here are a few of the advantages Monsanto plasticizers offer foam-makers:

Faster Fusion . . . Santicizer 141 and Santicizer 160 speed up resin-solvating action, boost production rates, and reduce costs.

Uniform Cell Structure . . . Monsanto Aroclor plasticizers contribute to better cell formation in foams by reducing the viscosity of the heated formulations to the best level for cell formation. This increases the efficiency of chemical blowing agents.

Lower Formulating Costs . . . Monsanto HB-40 is in wide use as a co-plasticizer in vinyls to reduce costs. The presence of HB-40 also reduces the migration of primary plasticizers from vinyls to nitrocellulose lacquers. Monsanto HB-40 now is readily available for bulk shipment from Akron, Ohio; Anniston, Alabama; and Perth Amboy, New Jersey.

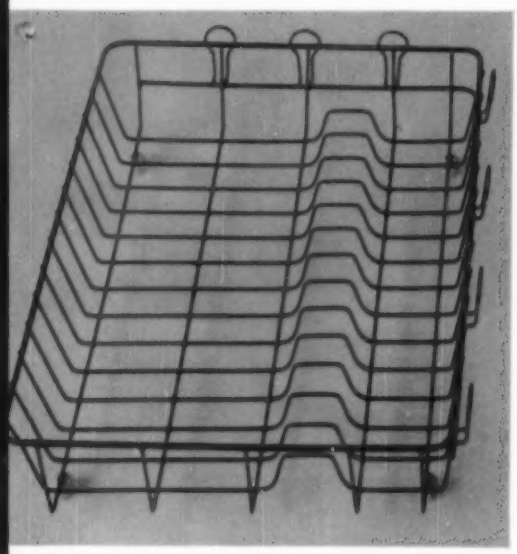
Controlled Texture . . . Monsanto DIDA upgrades the quality of foams by promoting uniform compression-deflection properties over a wide range of temperatures.

Vinyl Dispersions and Solutions

. . . Plastisol Moldings

Low Cost–Light Color . . . Monsanto HB-40 is an outstanding cost-reducer for plastisols. It is especially valuable as a co-plasticizer in rotational molding systems, where it helps control "gelling" rates and produce moldings of more uniform thickness. Monsanto HB-40 yields light-colored compounds with less need for pigment.

More Moldings Per Hour . . . Monsanto Santicizer 160, and other Monsanto fast-processing plasticizers, increase molding outputs by speeding up resin solvation and boosting fusion rates.



. . . Dip-Coated Products

High Soapy-Water Resistance . . . Monsanto DIDP resists the strong extracting action of soap and detergent solutions and helps prevent cracking and peeling. Test results (below) show the superior soapy-water resistance of Monsanto DIDP compared with standard dioctyl phthalate. (The test sample was a 40 mil sheet immersed for 24 hours at 50° C. in a 1% solution of Ivory soap. Formulation of the vinyl: 100 parts Opalon® 300 plasticizer as noted below: stabilizer ½ part DS-207.)

	Plasticizer % Weight	*% Loss (weight)*
DOP	30	1.10
	40	1.82
DIDP	30	0.02
	40	0.24

IVORY: Reg. Trademark of Procter & Gamble Co.

. . . Spray-on Solutions

Non-Toxicity . . . Monsanto has pioneered in the development of non-toxic plasticizers for food packaging products. Santicizer 141, Santicizer B-16, and Santicizer E-15 fully meet requirements of BAI and FDA. Santicizer 141 also contributes flame resistance, low-temperature flex, and low volatility, together with resistance to abrasion, oils, and greases.

. . . Heavy-Duty Coated Fabrics

Excellent Chemical Resistance . . . Monsanto Aroclor plasticizers impart excellent chemical stability to plastisol products because they "build" ability to resist acids, alkalis, and all common solvents.

How buying from a one-stop source saves money

Case 1

Supplier		Three Suppliers—Three Shipments
A	DOP	5,000 pounds
B	TCP	5,000 "
Monsanto	Santicizer 160	10,000 "
		Total Cost $6,500 (LTL)
		One Mixed Truckload From Monsanto
Monsanto	DOP	5,000 pounds
"	TCP	5,000 "
"	Santicizer 160	10,000 "
		Total Cost $6,300 (TL)
		You Save $200 on 20,000 pounds

Case 2

Supplier		Two Suppliers—Two Shipments
A	DOP	10,000 pounds
A	TCP	10,000 "
Monsanto	Santicizer 160	10,000 "
		Total Cost $9,850 (TL & LTL)
		One Mixed Tank Truck From Monsanto
Monsanto	DOP	10,000 pounds
"	TCP	10,000 "
"	Santicizer 160	10,000 "
		Total Cost $9,150 (TT)
		You Save $700 on 30,000 pounds

Costs based on price schedules of February 15, 1956.

Monsanto Plasticizers

Phthalates
Dibutyl phthalate
Diethyl phthalate
Dimethyl phthalate
Diphenyl phthalate
Dioctyl phthalate
Diisooctyl phthalate
Di-n-octyl-n-decyl phthalate
Diisodecyl phthalate
Santicizer* 160
Santicizer 602
Santicizer 603
Santicizer 606
Santicizer 611
Santicizer 613

Adipates
Diisodecyl adipate
Dioctyl adipate

Phosphates
Tricresyl phosphate
Triphenyl phosphate
Santicizer 140
Santicizer 141

Phthalyl Glycolates
Santicizer E-15
Santicizer B-16
Santicizer M-17

Sulfonamides
Santicizer 1-H
Santicizer 3
Santicizer 8
Santicizer 9

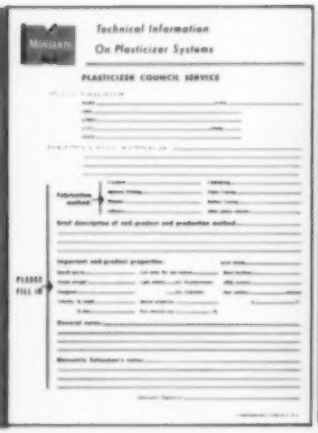
Sulfonamide Resins
Santolite* MHP
Santolite MS-80%

*Reg. U. S. Pat. Off.

Specialties
HB-40*
HB-20*
Santowax* R
Aroclor* 1221
Aroclor 1232
Aroclor 1242
Aroclor 1248
Aroclor 1254
Aroclor 1260
Aroclor 1262
Aroclor 1268
Aroclor 4465
Aroclor 5442
Aroclor 5460
Aroclor 2565

For Formulating Guidance . . .

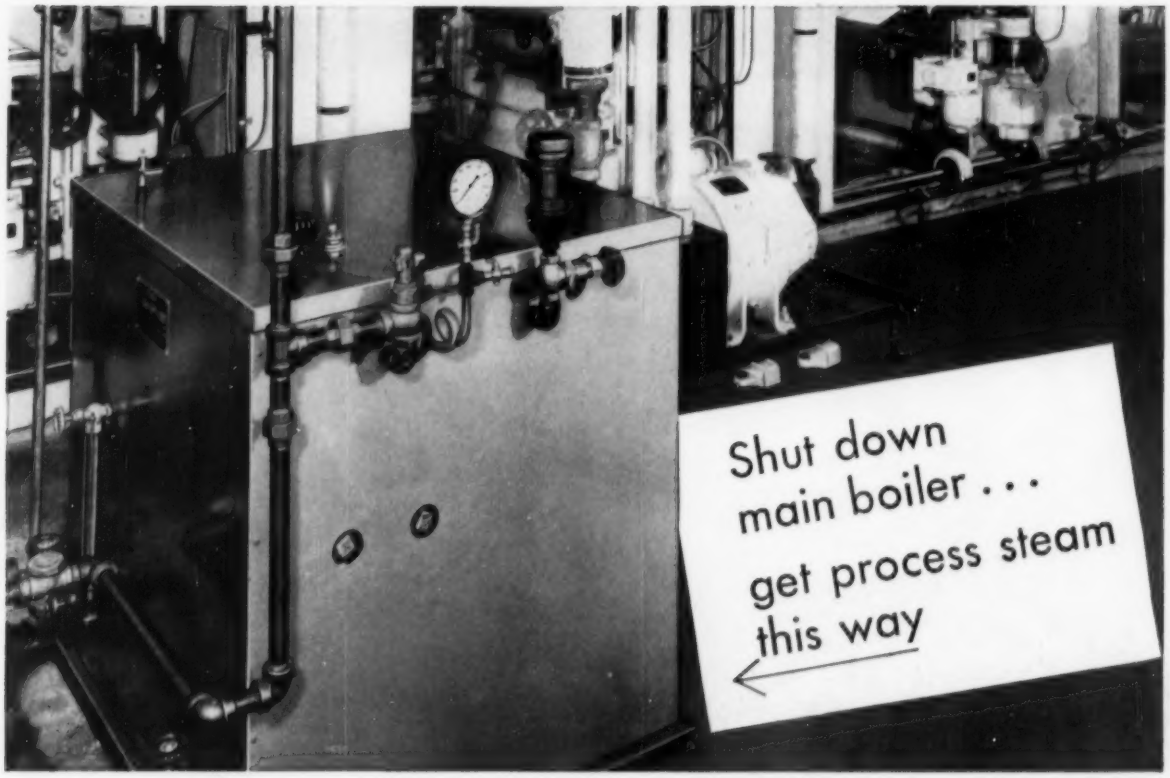
Your Monsanto representative will help you get quick and profitable guidance for improving your raw material mix, speeding up processing, or improving your products. Ask him to help you fill out a "Plasticizers Council" request-card, and submit it for technical group guidance. Ask him for an extra supply of request-cards for future use.


Technical Information
On Plasticizer Systems
PLASTICIZER COUNCIL SERVICE

Monsanto Chemical Company,
ORGANIC CHEMICALS DIVISION,
Dept. PL-2, Box 478,
St. Louis, Missouri

MONSANTO

Cut Steam Costs THIS SUMMER



with a Pantex Speedylectric Steam Generator

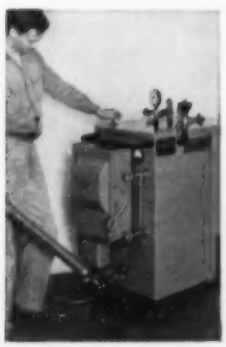
For as little as $685, you can install a Speedylectric Steam Generator adjacent to process equipment, and have process steam all summer without operating your main steam plant. DO IT NOW . . . many well-known plants save more than the cost in a single summer!

Speedylectric utilizes the electrode principle — the simplest, lowest-cost method of generating steam electrically. Steam is ready in ten minutes after you flick the switch. There are no coils, tubes or electric elements to scale or burn out . . . no open flame or low-water explosion hazards . . . no fumes, no smoke-stacks or other complicated installation problems. Connect to either 220, 440 or 550v outlet, connect piping, and you have an ever-ready source of steam that you can control precisely. Add these outstanding features to an unheard-of 98½% efficiency, and you have a real cost saver.

Speedylectric Steam Generators are available in 21 sizes, from 2 to 60 Bhp, from 15 to 500 Psi. Quick delivery and simple installation. WRITE FOR BULLETIN SG-100.

Among leading users are: Aluminum Co. of America • Boeing Airplane Co. • Celanese Corporation of America Cutler-Hammer, Inc. • Dow Chemical Co. • Eastman Kodak Co. • Ford Motor Co. • General Electric Co. Liggett & Myers Tobacco • Republic Steel Corporation • Shell Oil Co. • Westinghouse Electric Corporation

See us in Booth 11 at the Plastics Exposition



Speedylectric Steam-Jet Cleaner lets one man do the work of five. High pressure jet of dry steam and solvents quickly removes grease and dirt accumulations from machines and equipment *without* flooding floors. No need to stop nearby production or move machines outside. Completely safe and portable.

Pantex Manufacturing Corporation
Box 660H Pawtucket, R. I.
Send me complete illustrated data on:
☐ Pantex Speedylectric Steam Generators.
☐ Pantex Speedylectric Steam-Jet Cleaners.

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A NEW
COST REDUCING FEATURE

"AUTOMATION in PLASTICS"

NOW POSSIBLE WITH THE **Logan**
HYDRAULIC PREFORMER

FOR HIGH BULK MATERIALS

Patents Applied For

Rag or flock filled, melamine "Fines" or general purpose materials can be preformed automatically. Large die area permits production of maximum size preforms. Multiple cavities can be used for smaller preforms. Processing with high bulk materials in your plant becomes automatic if you own a Logan Preformer.

If You Need a Hydraulic Press,

Check LOGAN Before You Buy

Automatic molding with Logan horizontal transfer machines and using preforms of high-bulk-factor type materials is the new way to reduce costs. Logan also has a complete line of semi-automatic molding custom engineered presses for compression and transfer use. Their exclusive features will appeal to you.

You will find it profitable to discuss your production problem with a Logan Engineer.

SEE US AT BOOTHS 1231-1233

HYDRAULIC DIVISION
LOGAN ENGINEERING CO.
4901 WEST LAWRENCE AVENUE • CHICAGO 30, ILLINOIS

Oronite Isophthalic—
new superior raw material!

Epoxy Strengths at Unsaturated Polyester Prices!

Discover for yourself the cost advantages Isophthalic offers in the production of reinforced plastics. Evaluate this completely new raw material in your own laboratory now. Just phone or write the Oronite office nearest you for further information.

Flexural strength tests:

An Isophthalic unsaturated polyester test gave an average strength of 85,000 psi. By the same standard A.S.T.M. test, three commercial epoxies gave flexural strengths of 78,000 to 92,000 psi. The cost of producing such flexural strength formulations greatly favors Isophthalic polyesters.

Performance test:

An unsaturated polyester pipe section made with Isophthalic did not weep at 1900 psi. Epoxy pipe sections fail in the range of 2000 to 2200 psi. Phthalic anhydride polyester pipe sections start weeping at 300 psi, with excessive weeping at 1000 psi.

ORONITE CHEMICAL COMPANY

ORONITE CHEMICAL COMPANY

EXECUTIVE OFFICES: 200 Bush Street, San Francisco 20, California

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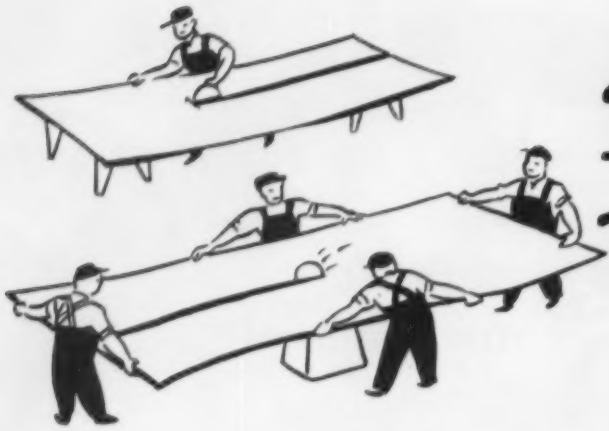
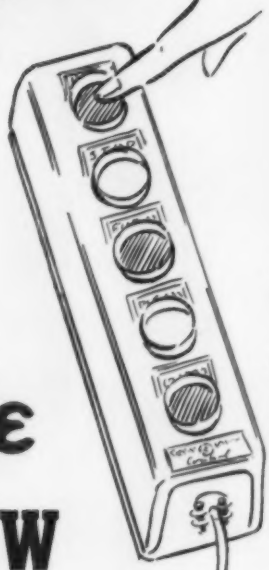
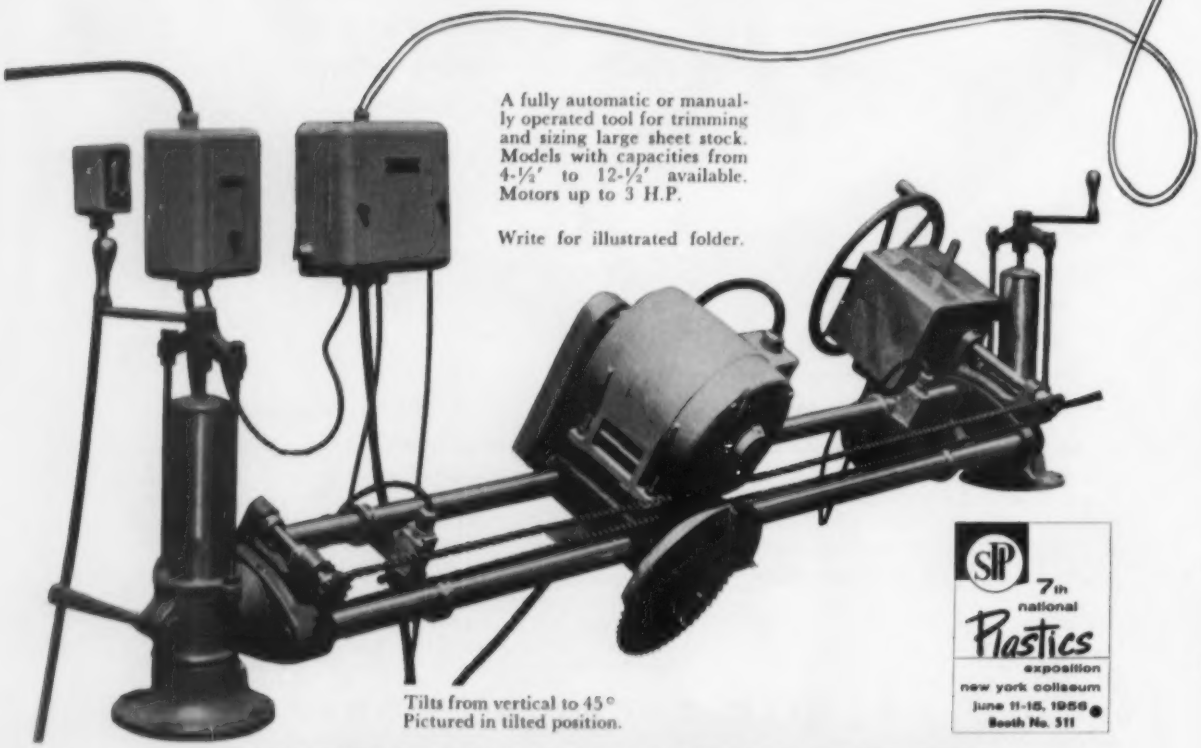


Doing it the hard way?

— it's fast and accurate with the

HENDRICK PANEL SAW





A fully automatic or manually operated tool for trimming and sizing large sheet stock. Models with capacities from 4-½′ to 12-½′ available. Motors up to 3 H.P.

Write for illustrated folder.

Tilts from vertical to 45°
Pictured in tilted position.

SIP 7th national Plastics exposition
new york coliseum
june 11-15, 1956
Booth No. 511

HENDRICK MFG. CORP.

MARBLEHEAD, MASSACHUSETTS

whatever the dimension

whatever the pressure

whatever the temperature

FJELLMAN AMERICAN

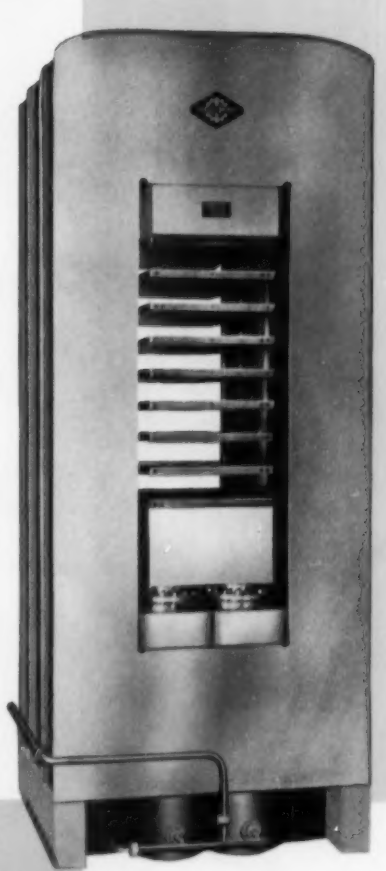
Hydraulic Hot Presses meet your requirements

In an industry possessing the limitless future of plastic, there's one modern hydraulic press which meets the exacting demands of plastic product lamination today and tomorrow—the FJELLMAN AMERICAN laminating press.

Fjellman American presses, used by leading plastic laminators the world over, are built to the highest standards of strength and accuracy for long service and minimum maintenance. For example, in Fjellman American laminating presses:

1) Finest Swedish steel is used throughout for rigid but simple construction.
2) All welding and platens are X-rayed for flawless assembly.
3) Platens of Swedish fire-box carbon steel are carefully ground to close tolerances.
4) Guided platens guarantee accurate alignment, assuring that all platens are parallel.
5) Absolute uniform pressure and temperature over the entire platen area provides high product uniformity under mass production conditions.

Fjellman American presses are equipped with American instruments, wiring and hardware for ease of maintenance. When needed, fully automatic loading and unloading equipment can be furnished.



This Fjellman American hydraulic press is 26'3" high; platen 51" x 100"; 2150 PSI; total pump pressure 5000 tons; daylight 10" between each platen. We manufacture other presses in all dimensions and pressure capacities to suit your particular needs.

Consult our engineering department for a survey of your specific requirements, or for complete information regarding range, dimensions, pressure, heating etc.

FJELLMAN AMERICAN INC.
P. O. Box 1205 **Joliet, Illinois**

FJELLMAN AMERICAN

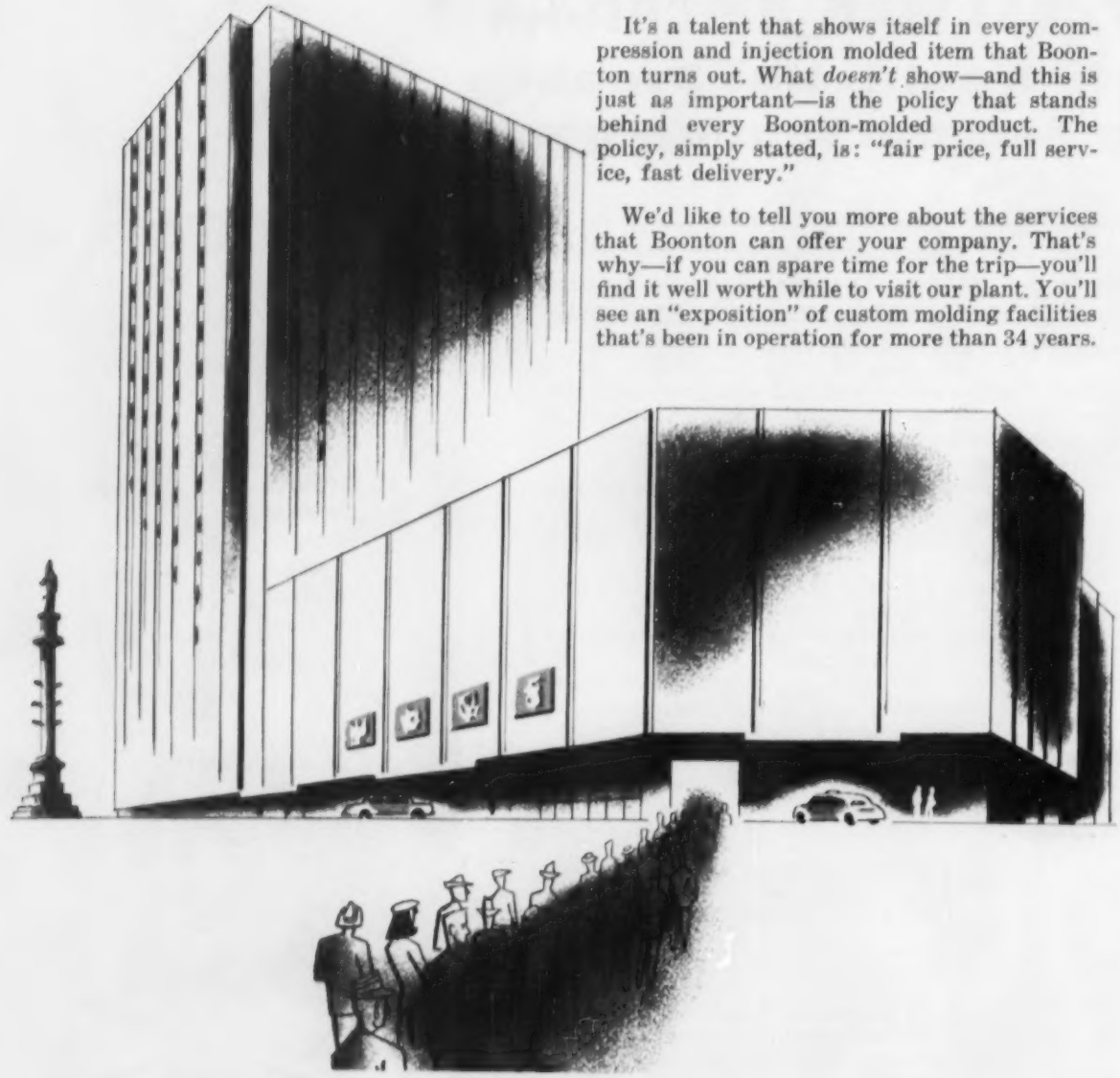
Now, don't misunderstand. We're not trying to re-name the New York Coliseum, scene of the 7th National Plastics Exposition.

See you at the "Boonton Coliseum!"

The "Coliseum" we refer to is the Boonton plant. There you will find an outstanding collection of skilled craftsmen and precision plastics machinery. To us, and to the many companies we serve, this combination of men and equipment makes the Boonton plant a real coliseum of custom molding talent.

It's a talent that shows itself in every compression and injection molded item that Boonton turns out. What *doesn't* show—and this is just as important—is the policy that stands behind every Boonton-molded product. The policy, simply stated, is: "fair price, full service, fast delivery."

We'd like to tell you more about the services that Boonton can offer your company. That's why—if you can spare time for the trip—you'll find it well worth while to visit our plant. You'll see an "exposition" of custom molding facilities that's been in operation for more than 34 years.



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BOONTON, NEW JERSEY

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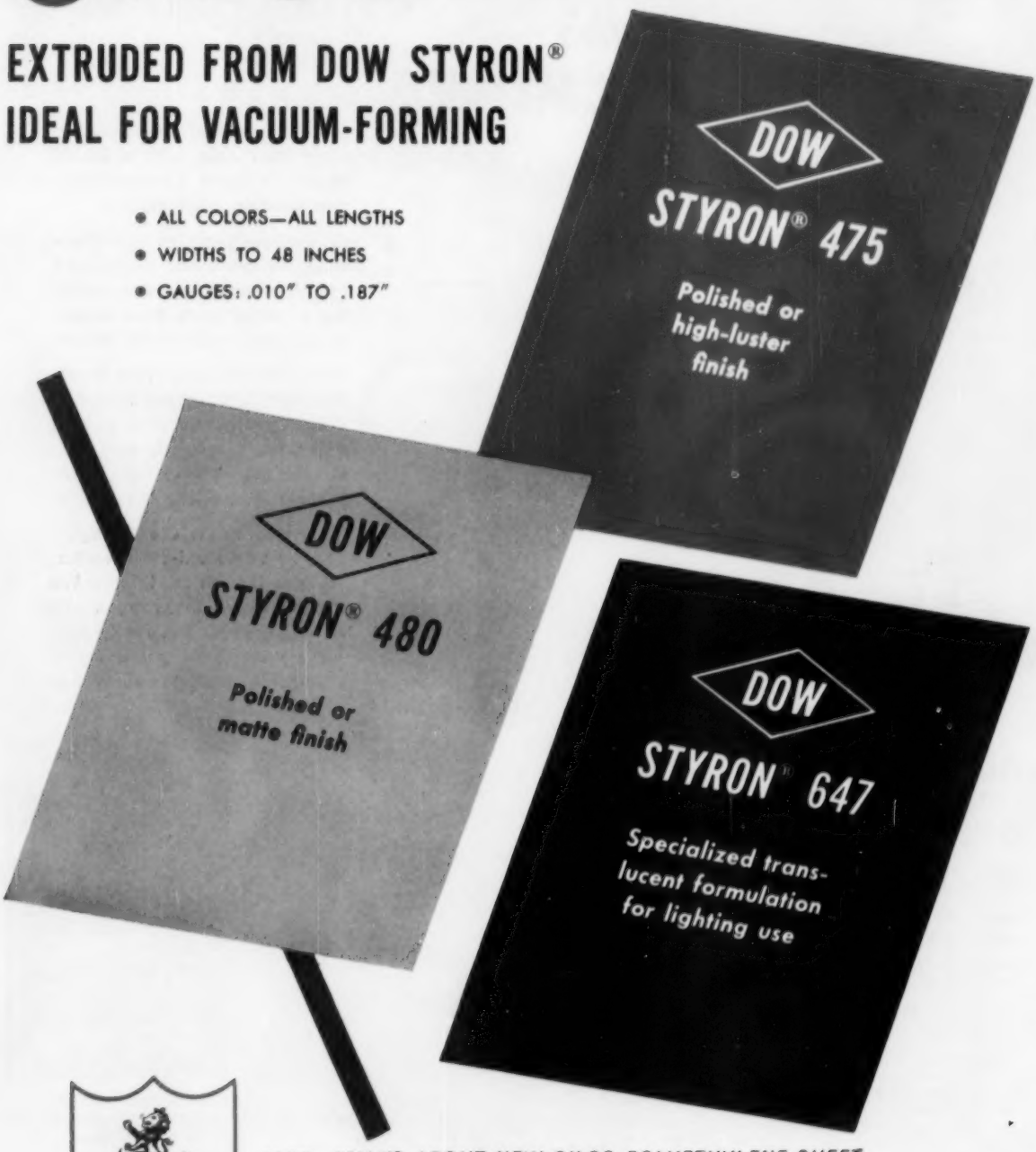
- ALL COLORS—ALL LENGTHS
- WIDTHS TO 48 INCHES
- GAUGES: .010" TO .187"



ALSO: ASK US ABOUT NEW GILCO POLYETHYLENE SHEET

THE GILMAN BROTHERS COMPANY

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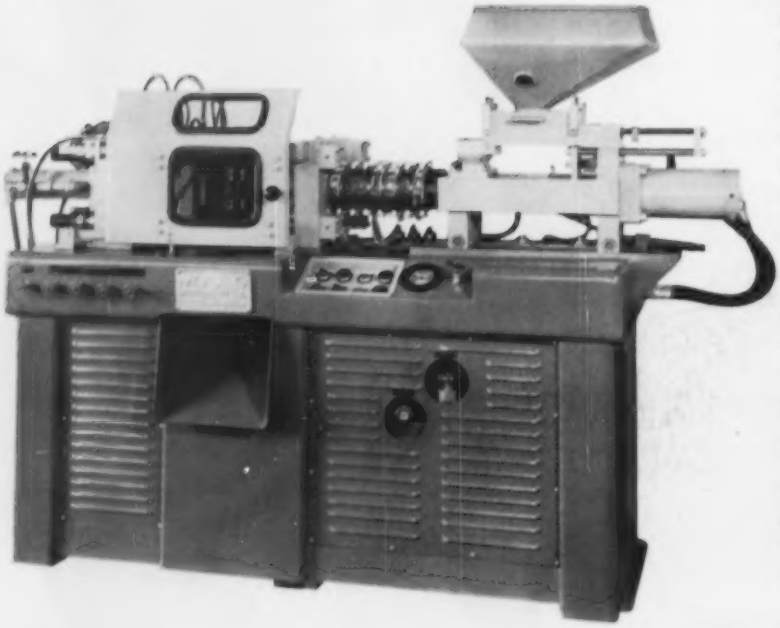
GET ON THE BANDWAGON with MOSLO HIGH-SPEED *Automatic Injection* MOLDING MACHINES



Molders say that long runs are now short runs with a Moslo Model 74 Super 2-ounce injection molding machine.

This unique machine was especially designed and engineered for high-speed injection molding of small parts from single-cavity and multi-cavity molds.

The production rate of the Moslo machine is so great that one custom molder is now getting 4½ times the hourly unit production than previously obtained from a competitive machine.

Illustrated below are examples of parts from multi-cavity molds. The possibilities are infinite. We know that a demonstration of a Moslo machine will really convince you—so bring your molds to our shop and let us show you.

The Moslo line includes these models.

Model 74-7—Super 2 ounce with 7" mold stroke

Model 74-12—Super 2 ounce with 12" mold stroke

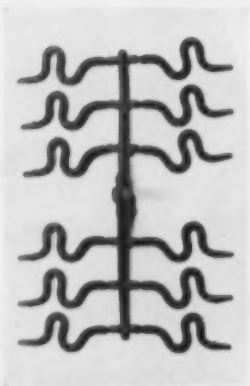
Model 75-8—High speed 3 ounce with 8" mold stroke

Model 75-15—High speed 3 ounce with 15" mold stroke

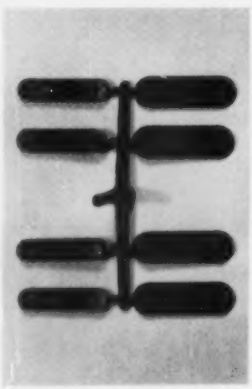
Model 76-8—Super 3 ounce with 8" mold stroke

Model 76-15—Super 3 ounce with 15" mold stroke
Famous Duplimatic for cord plug and insert work

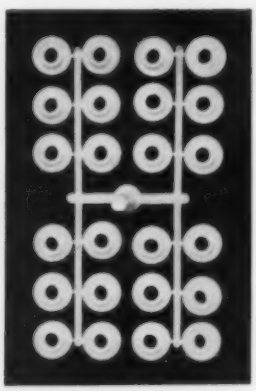
SALES REPRESENTATIVES NEEDED IN SOME AREAS



Vinyl Novelty Parts*
Molded from 27 grams of vinyl at 345 shots per hour.
***Molded on Moslo Model 74-7.**



Nylon Parts*
Molded from 25 grams of Nylon 210 shots per hour.

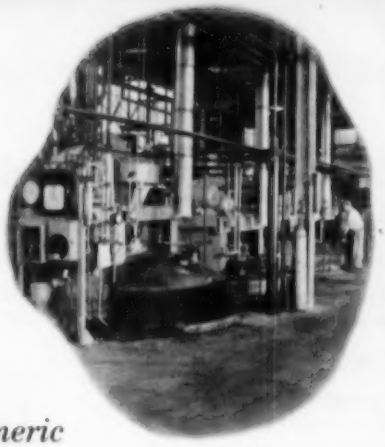


Nylon Bushings*
Molded from 42 grams of Nylon at 255 shots per hour.

MOSLO MACHINERY COMPANY
2437 PROSPECT AVENUE • CLEVELAND 15, OHIO

See us at the National Plastics Exposition, Booth Nos. 628 and 632

plasticizers



- **PARAPLEX** /*polymeric*
- **MONOPLEX** /*monomeric*

FROM ROHM & HAAS COMPANY

Compounders of vinyl products can choose from a variety of Rohm & Haas plasticizers ranging from monomeric esters—MONOPLEX plasticizers—to complex, high molecular weight polymers—PARAPLEX plasticizers. Used alone, or in combination, Rohm & Haas plasticizers offer vinyl compounders distinctive processing and performance benefits.

Whether your product demands plasticizers with resistance to migration, stability against heat or light, very low volatility, flexibility at low temperatures, resistance to extraction by a variety of solvents, both organic and aqueous, or good electrical properties, Rohm & Haas plasticizers can do the job effectively and economically.

Whether you are making floor tile or baby pants, high frequency cable jacketing or garden hose . . .

• • • here's what you should know about PARAPLEX and MONOPLEX plasticizers

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

Paraplex *polymeric plasticizers*

Paraplex G-25

- ***unexcelled permanence***
- ***excellent compatibility***
- ***high resistance to ultra-violet light***

Paraplex G-25 is a high molecular weight plasticizer which imparts unexcelled permanence. Properly stabilized vinyl compounds containing Paraplex G-25 offer the ultimate in durability. Paraplex G-25 has excellent resistance to extraction by gasoline, oil, water, soap and detergents, as well as freedom from migration in contact with lacquer, alkyd and varnish finishes. Compatibility with vinyl resins is excellent. Original physical properties are retained even after prolonged service at elevated temperatures.

Typical uses include: high grade upholstery sheeting and coated fabric, refrigerator gaskets, surgical tapes; insulation resistant to high temperature, coaxial cable, window channeling, electrical tapes.

Paraplex G-40

- ***high resistance to migration into rubber***
- ***high resistance to extraction by oil***

Paraplex G-40 is a high molecular weight polyester plasticizer which combines permanence of plasticizing action with moderate cost. Compounds in which Paraplex G-40 is used show good durability, as indicated by low losses due to volatility, resistance to extraction by aliphatic and aromatic hydrocarbons, and high resistance to migration into rubber and rubber-based materials. Paraplex G-40 is lighter in color than Paraplex G-25 but is not as compatible with vinyl resins at high plasticizer ratios.

Typical uses include: industrial hose and tubing, industrial and domestic flooring, shoe liners and counters, electrical tapes and industrial aprons.

Paraplex G-50

- ***good processing characteristics***
- ***very good over-all permanence***

Paraplex G-50 is a general-purpose polymeric plasticizer similar to monomeric plasticizers in its handling and processing characteristics. It is notably superior to dioctyl phthalate in resistance to extraction by oils and hydrocarbons, freedom from volatility, and resistance to migration into lacquers, rubber, and typical baked finishes. Vinyl compounds containing Paraplex G-50 are very stable, as evidenced by the retention of original properties after prolonged aging at high temperatures.

Typical uses include: insulation resistant to high temperature, upholstery sheeting, coated fabric, flooring, refrigerator gaskets, window channeling, surgical tapes, electrical tapes, shoe liners and counters, pigment dispersion vehicles, doll compounds.

Monoplex monomeric plasticizers

Monoplex DOS *(dioctyl sebacate)*

- ***outstanding performance at low temperatures***
- ***low volatility***
- ***resistance to extraction by soap and detergent solutions***

Monoplex DOS is an ester-type plasticizer widely used as a standard in vinyl compounds requiring flexibility at low temperature. It also provides low volatility, high plasticizing efficiency and excellent resistance to extraction by water, soaps and detergents. Like other plasticizers which impart low temperature flexibility, Monoplex DOS is susceptible to extraction by hydrocarbons and deficient on migration resistance. It is a very effective plasticizer for organosol and plastisol compounds.

Typical uses include: primary electrical compounds, sheeting and film for use at low temperatures, jacket compounds, strip-coating compounds.

Monoplex S-38

- ***excellent compatibility***
- ***low-cost permanence***

Monoplex S-38 is a low-cost primary vinyl plasticizer particularly noted for its good permanence properties. It is high in molecular weight and offers definite advantages over dioctyl phthalate. Monoplex S-38 is lower in volatility and better in resistance to extraction by oil and gasoline. Compounds exhibit excellent freedom from tack and exudation. Monoplex S-38 also proves helpful in improving the compatibility of secondary plasticizers.

Typical uses include: low-cost sheeting, flooring, automotive harness tapes, low-cost gasketing, electrical jacketing stocks.

Paraplex G-53

- ***high resistance to extraction by soapy water and oil***
- ***good compatibility at high levels of humidity***
- ***excellent resistance to marring of polystyrene***

Paraplex G-53, a relatively high molecular weight plasticizer, combines permanence and durability with the general handling and cost properties of a polymeric plasticizer of intermediate molecular weight. It possesses a high degree of resistance to extraction by aliphatic and aromatic hydrocarbons and to attack by soaps and detergents. Paraplex G-53 also is resistant to migration into and marring of lacquer, polystyrene, rubber-based compositions, and typical baked finishes. Compatibility with vinyl resins is very good.

Typical uses include: babywear, refrigerator gaskets, hospital sheeting, electrical and general-purpose tapes, insulation resistant to high temperature, upholstery sheeting, coated fabric.

Paraplex G-60

- ***excellent resistance to extraction by soap and detergent solutions***
- ***stabilization against effects of heat***

Paraplex G-60 is a light-colored, high molecular weight, ester-type plasticizer which provides effective heat and light stabilization in vinyl chloride polymers, nitrocellulose lacquers, and chlorinated rubber compounds. It imparts good flexibility at low temperature, excellent soap and detergent resistance, and low volatility loss. Paraplex G-60 lowers stabilization costs of vinyl compounds and permits high temperature processing.

Typical uses include: general-purpose film, babywear, food packaging and tubing, upholstery sheeting, coated fabric, glove-dipping compounds, flooring.

Paraplex G-61

This plasticizer is generally similar in properties and uses to Paraplex G-60. It is superior in retention of compatibility on long term exposure, has better stability against light, and is more resistant to extraction by oil.

Paraplex G-62

- ***excellent stabilization against effects of heat and light***
- ***good general permanence properties***
- ***good resistance to extraction by soap and detergent solutions***

Paraplex G-62 is a high molecular weight plasticizer which combines good permanence properties with excellent stabilization against heat and light. It has low volatility, good resistance to extraction by soap and detergent solutions, and good compatibility over a wide range of concentrations and conditions. Permits fast calendering and low stabilization costs, provides uniform color and excellent resistance to embrittlement and discoloration.

Typical uses include: general-purpose film, upholstery sheeting, coated fabric, refrigerator gasket stocks, garden hose, doll compounds, food packaging and tubing, welting, primary insulation, jacket stocks, flooring, insulation resistant to high temperature, window channeling.

Monoplex S-70

- ***stabilization against effects of heat and light***
- ***good performance at low temperatures***

Monoplex S-70 is designed specifically to impart flexibility at low temperature. It is a very efficient plasticizer with good processing properties and a marked stabilizing effect. It has lower volatility than conventional plasticizers for low temperature applications. The stability imparted by Monoplex S-70 not only permits fast, high-temperature compounding, but also affords savings in stabilizer costs. Organosols and plastisols prepared with Monoplex S-70 are of low viscosity and have excellent viscosity stability.

Typical uses include: garden hose, film and sheeting for use at low temperature, slush-molding compounds, electrical jacket stocks, automotive insulation.

Monoplex DCP *(dicapryl phthalate)*

- ***general-purpose plasticizer***

Monoplex DCP is a general-purpose monomeric plasticizer having performance characteristics, in vinyl resins, virtually identical to those of dioctyl phthalate. While it shows less resistance to extraction by oil and gasoline and lower plasticizing efficiency, Monoplex DCP withstands degradation by heat, light, and outdoor exposure slightly better than dioctyl phthalate. In plastisol and organosol compounding, Monoplex DCP provides low viscosity, both initially and upon aging.

Typical uses include: general-purpose replacement for dioctyl phthalate.

CHECK THIS CHART OF PERFORMANCE PROPERTIES AT 1550 PSI MODULUS

PLASTICIZER GRADE	% Plasticizer to give 1550 psi modulus	Loss by Volatization	PERCENT EXTRACTION LOSS BY Oil	Gasoline	Soapy Water (90°C.)	Bend Brittle (°C)	Hardness (10 secs.)
PARAPLEX G-25	40.5	0.5	+0.3	0.2	0.2	−14	73
PARAPLEX G-40	45.0	1.2	0.3	0.0	—	+10	76
PARAPLEX G-50	41.0	1.3	3.5	3.5	6.9	−13	72
PARAPLEX G-53	42.5	0.7	1.5	1.8	3.5	−11	70
PARAPLEX G-60	37.5	0.3	7.0	10.5	0.1	−20	73
PARAPLEX G-61	38.0	0.3	5.5	9.8	0.2	−16	73
PARAPLEX G-62	38.5	0.3	4.5	8.5	0.3	−15	73
MONOPLEX DOS (Dioctyl Sebacate)	32.5	4.0	14.5	22.2	0.8	−50	79
MONOPLEX DCP (Dicapryl Phthalate)	37.5	8.0	17.5	22.5	7.5	−25	75
MONOPLEX S-38	38.5	1.5	3.0	12.0	17.4	−11	69
MONOPLEX S-70	32.0	6.5	19.0	20.0	7.2	−50	80
DIOCTYL PHTHALATE*	35.0	8.1	9.0	19.0	7.7	−26	74

*not offered—included as control value only.

PARAPLEX and MONOPLEX are trademarks, Reg. U.S. Pat. Off. and principal foreign countries.

Chemicals for Industry

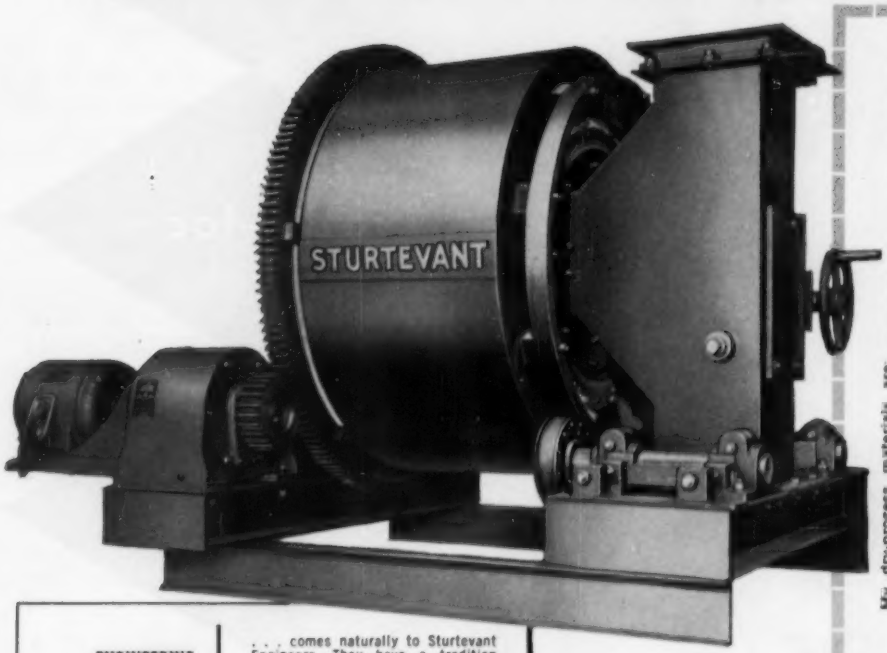
ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries

COSTS OF BETTER BLENDS CUT TWO TESTED WAYS



ENGINEERING BLENDING AND OTHER DRY PROCESSES TO SPECIFICATIONS

. . . comes naturally to Sturtevant Engineers. They have a tradition of solving dry-processing problems since 1873. Sturtevant custom-built equipment and plants are well-known for their low-maintenance-cost operation. If your problems include any of the processes listed on the coupon, it will pay you to investigate.

Sturtevant Dry-Batch Blenders:

1. **SPEED UP PRODUCTION WITH 4-WAY MIXING**
2. **SHORTEN SHUT-DOWNS WITH "OPEN-DOOR" DESIGN**

Batches from 500 to 40,000 pounds come out of Sturtevant Dry-Batch Blenders exactly as you want them. They are completely blended regardless of the varying weights, densities or fineness of the different ingredients. And no dust is lost in the process. **Four different vertical and lateral mixing actions** inside the sealed rotating drum achieve thorough blending in minimum time. Single lever control of a single gate speeds up loading and discharging.

"Open-Door" accessibility makes cleaning and maintenance a matter of minutes. This original Sturtevant advantage plus 75-year-tested rugged construction assures more output per machine-year. Check the coupon for more information.

STURTEVANT

Dry Processing Equipment

The "OPEN-DOOR" to *lower* operating costs over *more* years

CRUSHERS • GRINDERS • MICRON-GRINDERS • SEPARATORS
BLENDERS • GRANULATORS • CONVEYORS • ELEVATORS

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Please send me your bulletin on Dry Blenders ☐
Also bulletins on machines for:

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☐ MICRON-GRINDING ☐ SEPARATING ☐ BLENDING
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My dry-process materials are: _____

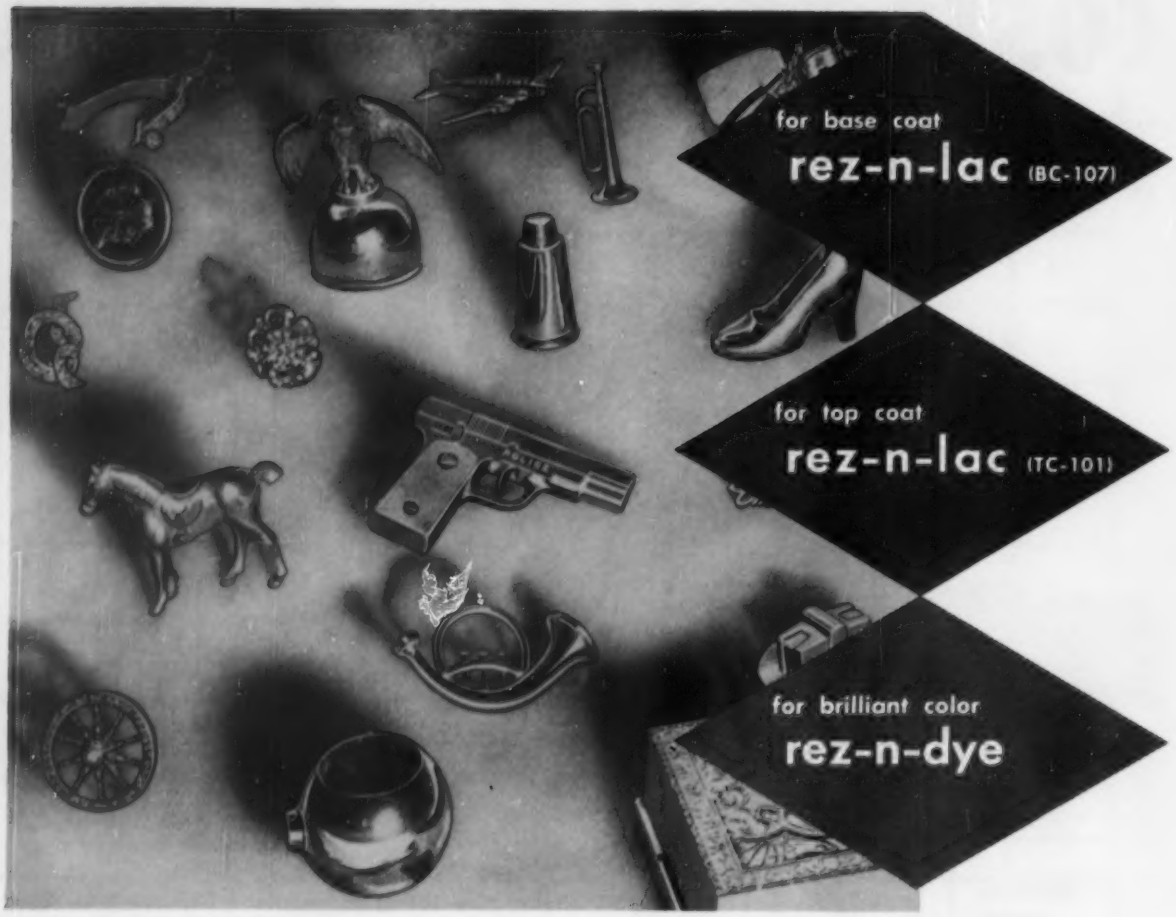
Desired capacity is: _____

Name _____ Title _____

Firm _____

Street _____

City _____ Zone _____ State _____



For superior finished products . . .

quality metallizers turn to Schwartz

For over a decade, metallizers the world over have turned to Schwartz Chemical Co. for technical advice and quality materials in the production of a multiplicity of consumer and industrial products.

Supplying the 3 basic needs of any metallizer, the base-coat, top-coat and Rez-N-Dye, Schwartz products have become standards in the industry.

Base-coat (Rez-N-Lac BC-107), top-coat (Rez-N-Lac TC-101) and Rez-N-Dye are all any metallizer needs to produce a finished article in a range of colors that covers practically the entire visible spectrum.

For trouble free metallizing, for prompt service and superior materials—one order form will bring all 3 to your plant—and they will be shipped by a manufacturer with a reputation for integrity since the inception of the industry itself.

Schwartz technicians are always at your service to aid you with any problems that may arise. They will be happy to serve you at any time. A letter or phone call is all that is necessary.

Send us your problems.

Serving the needs of the plastic industry

schwartz

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Manufacturers of Dyes — Lacquers — Cleaners and Cements for Plastics

Mr. Engineer!

AN ADVERTISEMENT . . . YES . . . BUT WRITTEN BY ENGINEERS FOR You

FACTS:

THE KIND YOU CAN SINK YOUR TEETH INTO...

● **Perfect frame-plate window uniformity (the heart of the press) assured by gang-machining four frame plates at one setting. Rough weight 200 tons.**

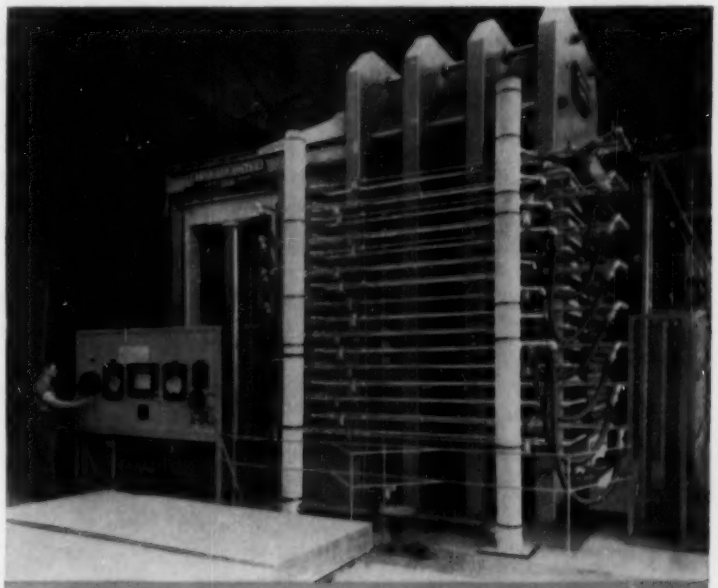
● Sideplate and platen steel receive double heat treatment.

● **Unique top bolster mounting, and platen and bolster guide design, eliminate distortion usually caused by thermal changes.**

● Laminated asbestos-paper and aluminum foil used for effective insulation.

● **Castings produced and all machine work handled in our own plants.**

● Closing speeds and automatic cycling meet any requirement, with number and size of openings to suit.



PRESS AND LOADING EQUIPMENT DESIGNED AND BUILT FOR GENERAL ELECTRIC COMPANY FOR DECORATIVE LAMINATES

Platen size 54" x 124"
Fifteen openings
Eight 23" rams
Hydraulic line pressure—3000 #
Platen pressure—1500 psi
With loading and personnel elevators
Weight of press, without elevators—300 tons

SEMI- OR FULLY-AUTOMATIC LOADING AND UNLOADING EQUIPMENT SUPPLIED TO MEET CUSTOMERS' PRESENT OR FUTURE PRODUCTS.

RESULTS OF RESEARCH WORK, INVOLVING PHOTO-ELASTIC STRESS ANALYSES AND ACCOMPANYING PHOTOGRAPHS, AVAILABLE TO THOSE INTERESTED.

UNDER SUPERVISION OF ADAMSON UNITED'S COMPETENT ERECTION ENGINEERS, LARGE PRESSES OF THIS TYPE ARE ASSEMBLED IN CUSTOMERS' PLANTS WITH MINIMUM EXPENSE AND DELAY.

CUSTOMERS ALWAYS WELCOME IN OUR MACHINE SHOPS AND FOUNDRIES. OUR ENGINEERS ARE AVAILABLE FOR CONSULTATION.

Net Results:

- **DEFLECTION AND THERMAL TOLERANCE MINIMIZED**
- **GAUGE UNIFORMITY OF PRODUCT ASSURED**

ADAMSON HYDRAULIC PRESSES

MANY SIZES FOR MANY PURPOSES • SPECIAL AND STANDARD DESIGNS
RUBBER • PLASTICS • HARDBOARD • LAMINATES

ADAMSON UNITED COMPANY

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SUBSIDIARY OF UNITED ENGINEERING AND FOUNDRY COMPANY
Plants at: PITTSBURGH • VANDERGRIFT • YOUNGSTOWN • CANTON • WILMINGTON (Lobdell United Division)

From sturdy fishing rods to handy soup kitchens!

Pittsburgh Selectron

POLYESTER RESINS

Now Ready For A Thousand New Uses

PITTSBURGH SELECTRON Resins have opened new opportunities for much greater product usefulness with reduced manufacturing costs.

When combined with suitable fillers these remarkable resins have been used to mold products that are lighter than aluminum with strength-weight ratios and impact resistance surpassing those of any other known materials. They also provide unusual resistance to weather, sunlight, heat, abrasion and many chemicals.

That's why SELECTRON Resins are today being used in a wide range of products. These can be as different in size, shape and weight as the new "glass" fishing rods so popular among anglers and the modern displays used in Heinz Fast-Food Kitchens. These displays were designed by the Milwaukee Industrial Designers, of Milwaukee, Wisconsin, and molded by G. B. Lewis, of Watertown, Wisconsin.

SELECTRON Resins are of the thermo-setting type. They polymerize to form solids with or without heat and with or without pressure. Parts in which they are used can be molded either by hand lay-up, direct molding, continuous lamination or pre-forming. These resins can also be used without fibers for casting, potting and impregnating.

We'll be glad to have one of our engineers discuss your problems with you without cost or obligation. This may save you time and money.

Send For FREE Booklet!

Write, wire or phone today for our new booklet containing descriptions of SELECTRON Resins and explaining many of the ways in which they can be used. Pittsburgh Plate Glass Company, Selectron Products Division, Gateway Center, Pittsburgh, Pa.

Just a few products in which Pittsburgh SELECTRON Resins are now used—

Aircraft structural parts
Radomes for electronic equipment
Life floats
Ballistic panels
Helmets
Boat hulls
Machinery housing and guards
Trays
Tote boxes
Food lockers
Garbage pails
Baskets for automatic dishwashers
Baskets for automatic washers
Wash tubs
Tool chests
Shipping containers
Instrument cases
Laundry hampers
Kitchen containers
Fishing rods
Sinks
Street signs
Traffic signs
Fluorescent light fixtures
Television cabinets
Loudspeaker housings
Gas meter housings
Structural panels for offices and homes
Door and transom lights
Awnings and canopies
Greenhouse panels
Skylighting
Molded chairs
Prefabricated houses and garages
Truck bodies

PITTSBURGH Selectron

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS • FIBER GLASS

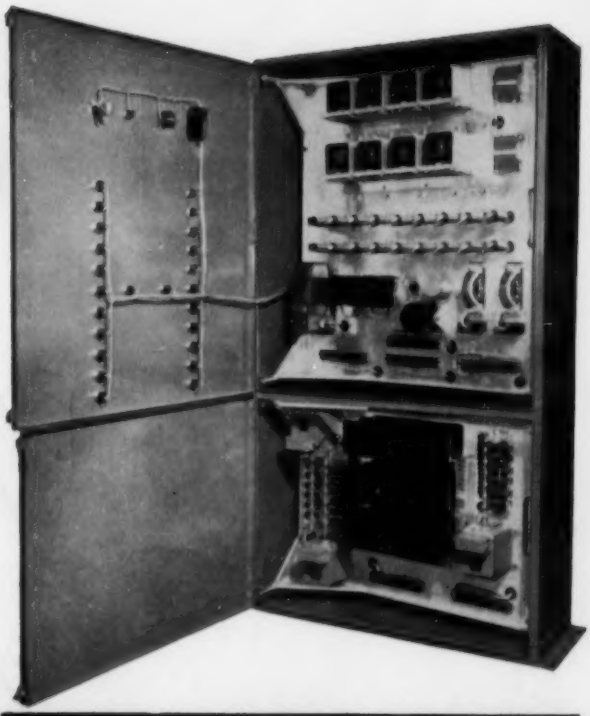
PITTSBURGH PLATE GLASS COMPANY

IN CANADA: CANADIAN PITTSBURGH INDUSTRIES LIMITED

NEW!
DUAL CHANNEL AUTOMATIC CONTROL BY

Tracerlab

MAKES POSSIBLE AUTOMATION IN PLASTIC SHEET



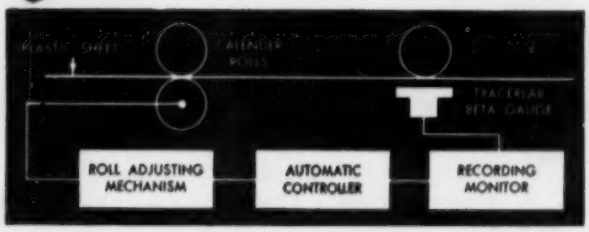


Diagram of operation shows how Tracerlab's Dual Channel Automatic Control can be applied to your equipment to give you completely automatic production.

MATCH YOUR SKILL AGAINST THE MACHINE!

Visit our simulated plastics plant at booth 1140, National Plastics Exposition, where this new control will be shown for the first time to the plastics industry.

See if you can correct manually an "off spec" sheet as accurately and well as this fully automatic control.

At last, here is the feedback correction and control equipment that makes *automation* possible in plastic sheet thickness control.

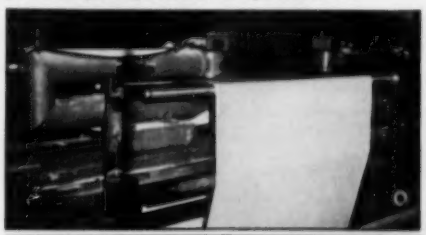
Tracerlab Beta Gauges continuously "sense" sheet thickness and "report" it to the automatic control element. Should gauge vary from your preset tolerances, the controller *instantly and automatically* applies correction to the calender rolls without need for operator attention!

RESULT: you get these direct benefits:

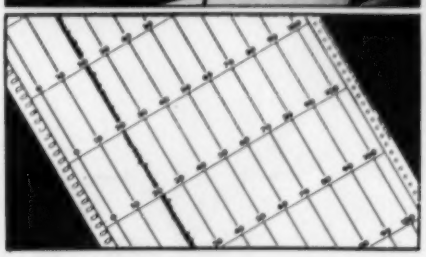
- ***waste and "off-gauge" production is cut to near zero.***
- ***precise, automatic control of gauge. No shutdowns for manual gauging.***
- ***you eliminate customer complaints and rebates due to off-specification gauge or yield.***
- ***faster start-up and gauge change, freeing operators for other productive work.***
- ***permanent chart records of production for each shift.***
- ***accurate, reliable gauging — even on embossed stock.***

And all these things add up to more efficient production, more output per shift and greater profits.

WRITE TODAY FOR DATA. "Automatic Process Control" tells how you can put automation to work in your plant earning greater profits for you.



Tracerlab Beta Gauges monitor both sides of wide plastic sheet — "report" thickness variations to dual channel control for correction.



Production chart shows precise gauge control possible with Tracerlab's Dual Channel equipment.

Tracerlab KELEKET *Tracerlab*

130 High Street, Boston 10, Mass.
2030 Wright Avenue, Richmond 3, Calif.

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CLEVELAND • LOS ANGELES • WASHINGTON • CHICAGO • OTTAWA

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Hurlbut's

150 Years of Progress

Looking back at the long history of our company, we, who manage its affairs today, are guided by a deep sense of responsibility to maintain its cherished traditions. To our customers, an unqualified assurance of highest quality and courteous relations in our dealings with them.

To our employees a well-balanced policy of maintaining high wages, liberal fringe benefits, and friendly working conditions. To our suppliers, a sense of loyalty arising from long faithful service and finally, the responsibility to our company of charting a sound course to assure its growth and progress. In the performance of our daily work, and future planning, all of us at the Hurlbut Paper Company are aware of these traditions and are inspired by the opportunities that lie ahead of us.

E. G. Bilby

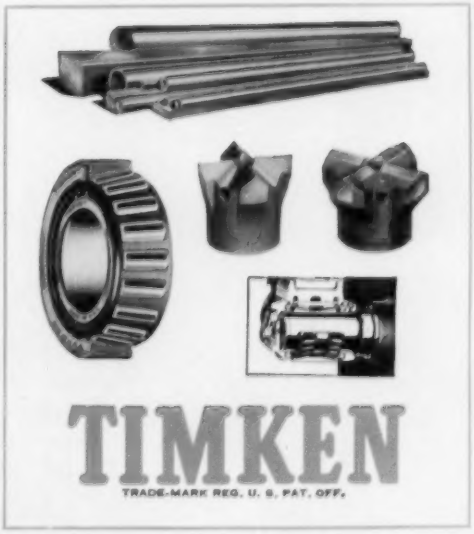
Our 150th Anniversary Year

Hurlbut
PAPER COMPANY
South Lee, Massachusetts

You mean what you say, when you say "TIMKEN"

IF you are content with just any old kind of tapered roller bearing, steel or rock bit, of course you don't specify "Timken". By the same token, when you want highest quality you don't specify anything *but* "Timken". To make sure you get what you want—to safeguard your reputation and ours—we stamp "Timken" on every product we make. When you say "Timken" we know you *mean* a product made by the Timken Company . . . because, as everyone is aware, "Timken" is a trade-mark, not *just a type of product.*

When you purchase tapered roller bearings, alloy steel bars, seamless steel tubing or removable rock bits, always look for this famous legal identification. When you see it, you know there are over 55 years of experience behind it. When you *say* it, you're saying exactly what you mean: "I want the best." The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".



TAPERED ROLLER BEARINGS • REMOVABLE ROCK BITS • FINE ALLOY STEELS

look...

it's

TITANOX®

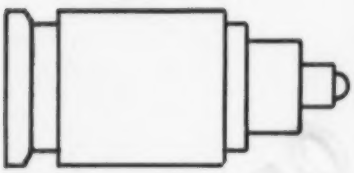
You'll never get a wrong number when you use TITANOX—that is, in your line of plastic products.

As whitening, brightening and opacifying agents, nothing can surpass TITANOX titanium pigments for adding eye-appeal to plastics. Titanium Pigment Corporation (subsidiary of National Lead Company), 111 Broadway, New York 6, N. Y.; Atlanta 5; Boston 6; Chicago 3; Cleveland 15; Houston 2; Los Angeles 22; Philadelphia 3; Pittsburgh 12; Portland 14, Ore.; San Francisco 7. In Canada: Canadian Titanium Pigments Limited, Montreal 2; Toronto 1.

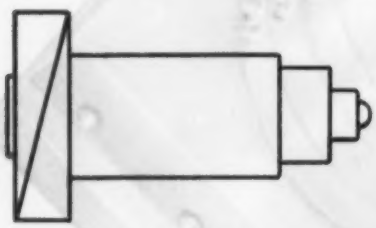
INJECTION MOLDERS

BOOST PRODUCTION!

IMS REPLACEMENT HEATING CYLINDERS INCREASE PRODUCTION 5 TO 50% REDUCE MAINTENANCE COSTS UP TO 60%



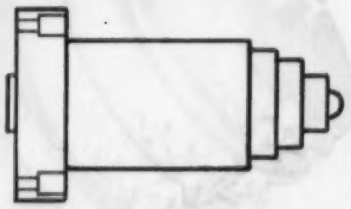
IMS Jumbo Heater (cost about $1995.00) on Reed 10 D-8 machine upped production 43%. *No* maintenance expense in 24 months operation! Nearly 1 out of every 5 "Reed-8's" now use IMS heating cylinders!



IMS Standard Heater on 12 oz. Watson Stillman (cost about $2275.00). Boosted production 14½%. Reduced total maintenance and nozzle costs from $1875.00 per year to $340.00 per year!

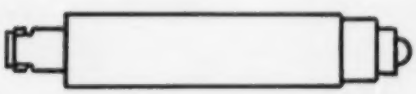
Yes, its a fact! Over 700 IMS uniform design heaters installed on virtually every make and model of injection machine are setting new records for faster cycles at lower heats—making older presses outproduce new ones, sharply cutting down-time and costs for heater repairs! Here are a few interesting case histories.*

*We don't use testimonial advertising, but will furnish names of these users on request.



IMS Intermediate Heater (cost about $3275.00) on 16 oz. HPM machine molding butyrate. Increased production 18%. Reduced maintenance expense from $2800.00 per year to $680.00. Over 50 IMS heaters on 16 oz. HPM's alone!

IMS Intermediate Heater on 350T Reed on polyethylene. Boosted production 50%. Reduced downtime and maintenance cost in first year from $3000.00 to 0! Cost about $3400.00 and worth twice that according to users who know!



IMS Standard Heater on Lewis 6 oz. machine (cost about $1675.00) cut cycle from 48 seconds to 28 seconds. Boosted capacity to 8 oz. styrene, and paid for itself fully in 10 months *from extra molding profits alone!* "Made us fully competitive for the first time," says one user.

Send Today for Your "HEATER HOW BOOK" And See How Easy It Is To Install an IMS HEATER!

YES—THERE'S NEW LIFE FOR OLD INJECTION MACHINES WITH IMS HEATERS!

IMS

INJECTION MOLDERS SUPPLY CO.

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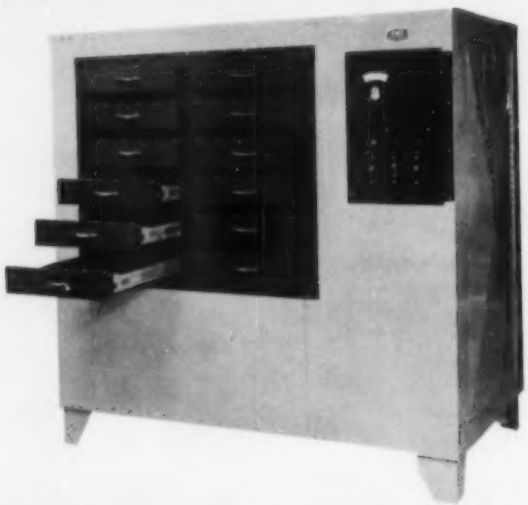
INJECTION MOLDERS.....

SPECIAL IMS NYLON DRYING OVEN



NYLON SPECIALTIES

BUILT-IN DEHUMIDIFIER

Sealing Drawers! ½ HP Fan! 10 KW Heat for Quick Recovery: The Only Oven Built Expressly for All Thermoplastic Work. Price Complete for 220-volt Operation $1638.50

SPECIAL IMS NYLON ANNEALING TANKS

5 Gal.....$210.60
10 Gal.....$284.50
25 Gal.....$464.00

Bottom Drain—Side Heat Only —Based on Dupont Suggestions for Safe Use of Hitec Salt or Wax

IMS NYLON NOZZLE KITS

WITH NOZZLES BASED ON DUPONT SUGGESTIONS

MODEL A— with Variac Control

Price, complete with 1¾"—8 thread, 5" nozzle, 3/16" orifice, ½" or ¾" radius nozzle.....$176.00

MODEL C— with Pyrometer

Price complete as shown with 1¾"—8 thread nozzle 3/16" orifice, ½" or ¾" radius.....$410.50

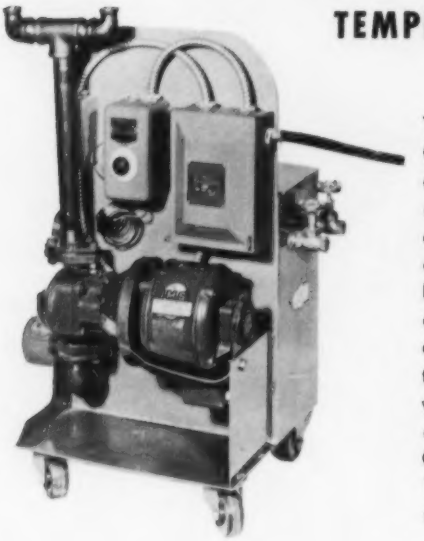
Write for prices on other nozzle types.

Send for our 1956 Nozzle Catalog today. You'll find all styles of nylon nozzles described and priced on pages 32-35—with technical notes on nylon molding. Prompt service on all kinds of nozzles by the world's largest and most experienced nozzle specialists.

INJECTION MOLDERS SUPPLY CO.

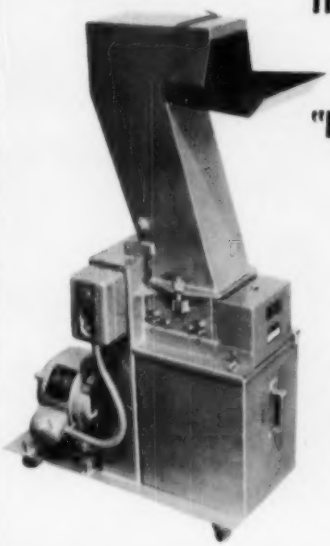
.....BOOST PRODUCTION!

FOR CONSTANT MOLD TEMPERATURES



The IMS Economy Circulator. Priced at only $369.50 complete (oil model for heats to 450° at $462.50). Duplicates performance of mold heaters costing up to 6 times as much. Developed by a molder for molders. Compact — only 15" x 22½" floor space.

The most popular—and most copied "Beside The Press" GRINDER!

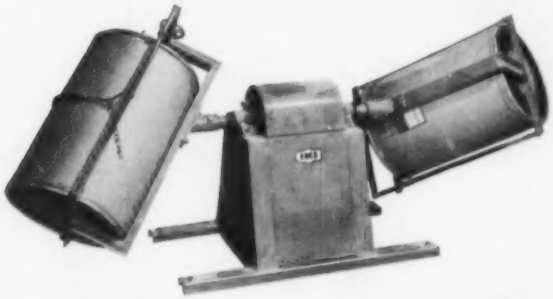


The IMS M-3 6½" x 7" throat sprue grinder—rugged—simple in design. Easiest to clean. Built-in throat clearance bar. Casters. Catch Pan.

PRICE Complete with 1 HP Motor and Starter.....$548.50

IMS DRUM TUMBLERS

FOR ALL COLORING AND MIXING OPERATIONS

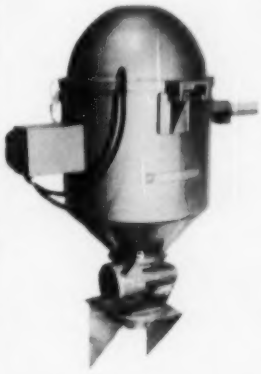


¾ HP Model.....$498.50
Takes drums up to 33" high x 22" in diam.

2 HP Model.....$785.00
Takes drums up to 37" high x 23¼" in diam.

3 HP Model.....$1185.00
Takes drums up to 45" high x 24" in diam.

IMS VACUUM MATERIAL HOIST



Economically Unloads Sealed Drums and Palettes Without Contamination

Automatically Keeps Hoppers Full

Completely Self Contained. Easy to Clean. High Capacity.

Price complete.....$395.00
For 110 volt operation only

"Just Plug It In"—Does Not Use Costly Moisture-Bearing Compressed Air.

Send for Our Plant Equipment, Nozzle and Heating Cylinder Catalogs Today!

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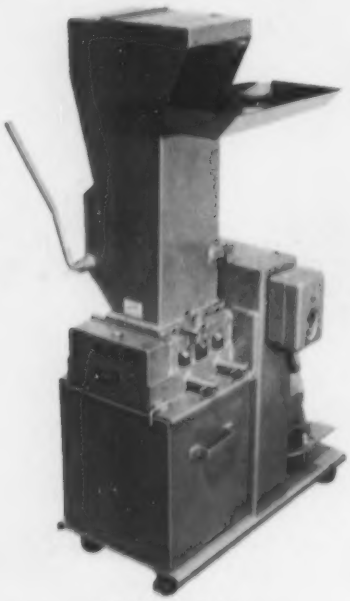
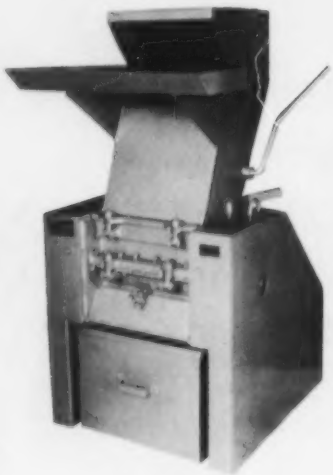
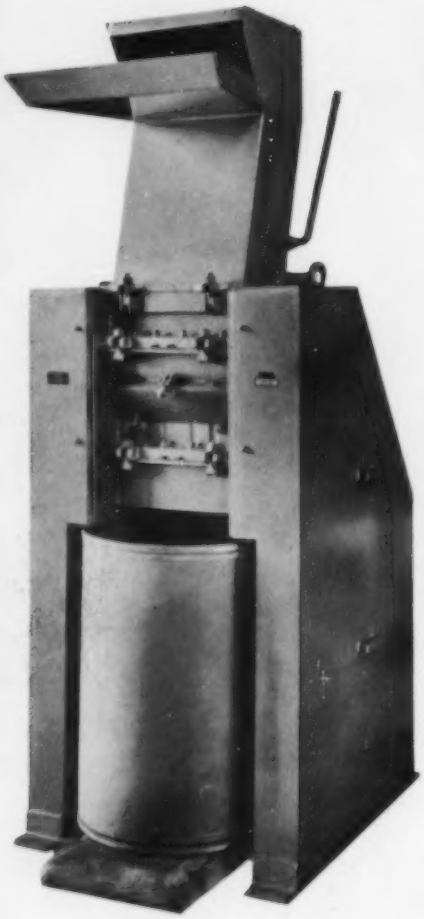
HERE'S HOW IMS MOLDER DESIGNED SCRAP GRINDERS SAVE YOU MONEY!



IMS Model M-4
All-Purpose Beside-the-Press Sprue Grinder. 5⅛" x 8½" Throat. Priced at $768.50. Complete with 2 HP Motor and Starter.



IMS Model M-40
Single Stage 11 x 17 Throat. Priced at $1795.00. Complete with 7½ HP Motor.



IMS Model M-400
Two-Stage—High Output. Priced at $2975.00. Complete with 10 HP Motor.

Don't let this little photo fool you! This is a BIG Grinder

Take the M-400 at right above—it replaces 2 to 3 conventional grinders. Labor saving? Of course! It does with 10-15 HP what other machines do with 40-50 HP in only 1/5 the floorspace. Or the M-40 (center). It pays for itself in short order in scrap and labor saved because its large 11 x 17 throat takes **BIG** moldings right at the press. And the handy, compact M-4 All-Purpose Grinder (left) gobbles up those round, hard-to-grind parts because the built-in throat clearing bar allows the operator to force them down into the cutting chamber **safely.**

Still other **molder designed** features cut maintenance cost: blades are uniform and interchangeable on the M-4, M-40 and M-400! Screen assemblies are **REINFORCED,** and lift right out for easy cleaning. Compare IMS grinders! You'll see they are built to **practical specifications,** and are already setting **NEW STYLES** in grinder design. Many IMS features are being copied, but **only** on IMS Grinders do you get **ALL YOUR IDEAS BUILT RIGHT INTO ONE MACHINE!** Result? Your IMS Grinder installations will pay for themselves within a few months!

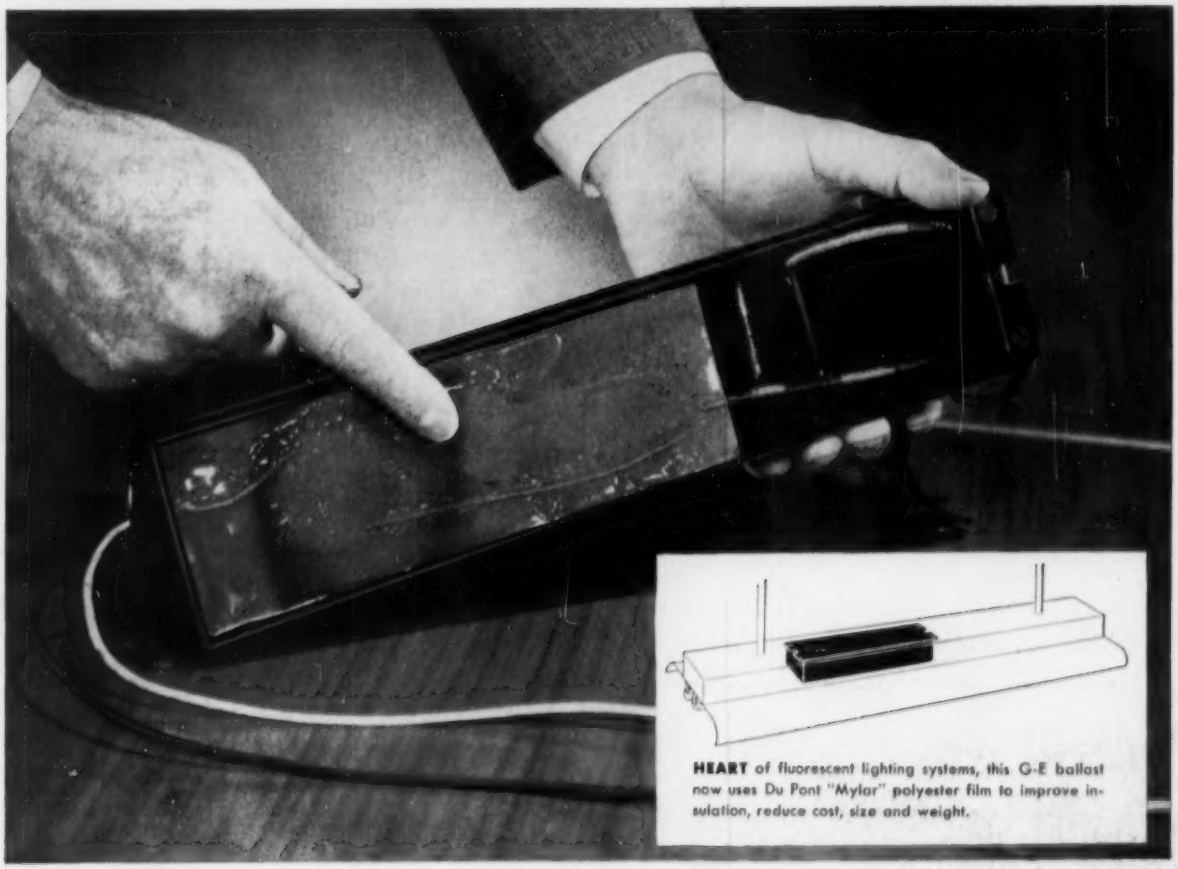
Order Today! Prompt Delivery. Complete Specifications on Request.

IMS

injection molders supply company

3514 Lee Road WYoming 1-1424 Cleveland 20, Ohio

MYLAR provides improved insulation...*



HEART of fluorescent lighting systems, this G-E ballast now uses Du Pont "Mylar" polyester film to improve insulation, reduce cost, size and weight.

G. E. reduces cost and weight by using Du Pont MYLAR® in ballast

General Electric selected "Mylar" as the insulating material for many of its fluorescent lamp ballasts.

Reasons? First, they needed a tough material with high dielectric strength. Next, it had to be easily applied and economically feasible.

Because of the hot potting compounds, the insulating material had to resist heat and chemicals. Lastly, it had to be thin and lightweight in order to provide compactness for reducing ballast space in fluorescent fixtures.

This successful application is only one of the many ways that versatile "Mylar", used alone or in combination with other materials, is making possible superior performance in capacitors, coils, motors and a host of other electrical products.

Perhaps "Mylar" can help *you* solve a knotty development problem or improve product performance. For more information on this unique polyester film and its applications in your field, send in the coupon for a fact-filled booklet. Be sure to indicate the type of application you have in mind.

DU PONT
REG. U.S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
...THROUGH CHEMISTRY

DU PONT
MYLAR®
POLYESTER FILM

***MYLAR** *is Du Pont's registered trademark for its brand of polyester film*

E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room M-6, Nemours Bldg., Wilmington 98, Del.

Please send the new booklet listing properties, applications, and types of "Mylar" polyester film available (MB-4).

Application _____

Name _____

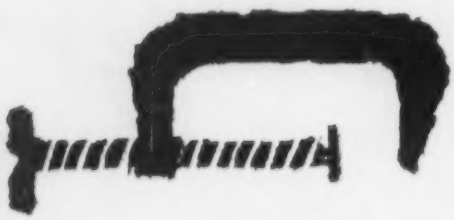
Company _____

Address _____

City _____ State _____

WYNNE WOOD BOARD
OFFERS NEW PRECISION
NEW ACCURACY

Precision to specification, uniform density, homogeneous cross sectional structure, more highly refined than ever before — Wynne Wood offers great opportunity for industrialists and architects. Each day, new applications are discovered, whole new fields of usage are opened. Perhaps these remarkable boards — Wynne Wood 60, Corstoc or Arcatex — are the answer to your problem.



some Wynne Wood applications:
furniture and cabinetry
counter tops
sub and under flooring
school furniture

Wynne Wood moisture controlled boards are now available in 40, 50 and 60 pound densities, in fractional thicknesses from ¼" to 1¼". Standard size 4' x 8'. All board accurately finished to .005". Can be veneered, painted, stained. Used for overlay (plastic or veneer), as a core material or as a finished product in itself.

Samples for your examination and individual testing will be furnished promptly and without charge.

Wynnewood products technical staff is available to help you adapt this new product to your uses. For complete information write

Wynnewood PRODUCTS COMPANY DALLAS 24, TEXAS

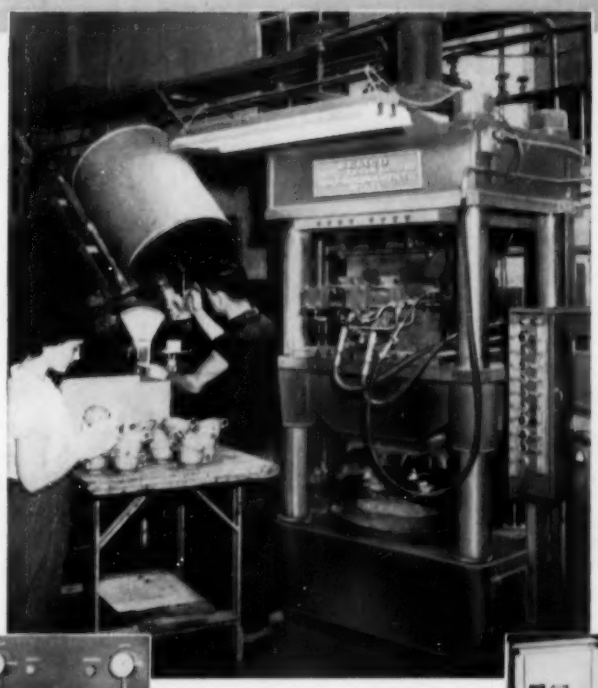
ONE OF A BATTERY OF PRESSES

now being installed at APPLIED PLASTICS

Built and Designed by ERIE ENGINE & MFG. CO.

Here is one of a line of EEMCO Hydraulic Presses especially designed and built by Erie Engine & Mfg. Company to fit the particular needs of the Applied Plastics Company's operation. Due to the many different jobs common to a custom molding shop, they needed presses which were adaptable to various cycles of compression molding and transfer molding. These presses are designed to handle any job and operate automatically.

The set-up man adjusts pressure required, speed of closing, opening speed and the required timing cycle. All the operator does is press a button for start of cycle.



"Production increased . . . fewer rejects" says
LLOYD MOORE
Pres., APPLIED PLASTICS CO.
ERIE, PA.

"We find that our EEMCO presses have increased production and cut down rejects. The human element of error has been practically eliminated through the automatic cycle and pressure controls, which also allow for more constant quality and more productive work schedules. Less skilled operators are now able to turn out a steady flow of first quality work in less time."

Pictured above is one of the EEMCO Presses installed at Applied Plastics. This press has platen area of 36" x 36" and capacity of 314 Tons.

EEMCO can help you, whether you need 1 press or a battery of presses—with or without controls.

In addition to standard size presses, EEMCO designs and builds units to meet your specifications.

PRESSURE CONTROL

Controls fast closing speed—allows complete flexibility of pressure adjustment to suit each job.

CYCLE CONTROL

Controls may be set for automatic operation of the cycle desired—for either compression or transfer molding.

EEMCO

Write or wire for complete details.

ERIE ENGINE & MFG. CO.

12 ST. & EAST AVE., ERIE, PA

Designers and builders of a complete line of Mills and Hydraulic Presses for the RUBBER, PLASTICS, FIBERGLASS and WOOD PRODUCTS INDUSTRIES.

Celanese

CORPORATION OF AMERICA

invites you to test the new

FORTICEL*

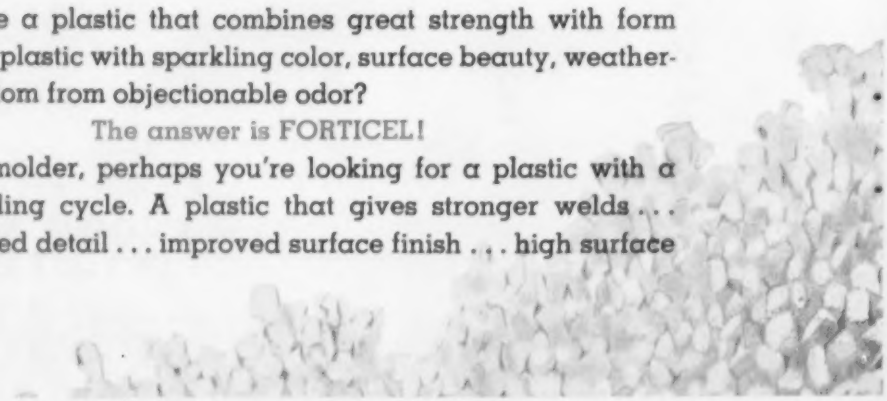
(CELLULOSE PROPIONATE PLASTIC)

High Performance Thermoplastic Molding Material with Outstanding Range of Balanced Properties... Available in Choice of Colors and Formulations

Can you use a plastic that combines great strength with form retention? A plastic with sparkling color, surface beauty, weatherability, freedom from objectionable odor?

The answer is FORTICEL!

If you're a molder, perhaps you're looking for a plastic with a shorter molding cycle. A plastic that gives stronger welds . . . superb molded detail . . . improved surface finish . . . high surface



luster, that requires no polishing or buffing.

The answer is FORTICEL!

Or you're a fabricator who needs a plastic with high impact strength. A highly machinable plastic that can be sawed, cut, drilled, threaded and punched with far less danger of stress lines and crazing.

Again, the answer is FORTICEL!

For this brilliant new Celanese plastic combines —in a single material—a fine balance of color, surface beauty, freedom from objectionable odor with all the most wanted physical properties.

Being a cellulosic, Forticel is a naturally tough material. Its impact strength is a measure of its toughness. Because it is free from objectionable odor, it is the perfect plastic for personal articles such as shaver housings and cases, sunglass frames, toothbrushes.

Where machinability is of vital importance, as in the fabrication of fountain pens, mechanical pencils, scale model trains, and appliance housings, Forticel again meets the most rigid specifications.

NEW FACILITIES FOR FORTICEL

To be certain that the supply of Forticel *raw materials* will be adequate to meet the anticipated demand for this outstanding plastic, Celanese has installed new facilities for their production. This will insure a dependable source of supply. These facilities will produce propionic acid and other petrochemicals necessary to Forticel manufacture.

AVAILABILITY

Forticel is available in a full color range, and supplied in uniform pellet size. If you haven't already done so, you should evaluate this brilliant new plastic immediately. What it can do for personal articles is an indication of the promise it holds for a variety of fields: automotive, electrical, household, fashion, sports and toys.

Send for our new product bulletin on Forticel. It tells the complete Forticel story from its chemical and physical properties to its molding and fabrication. Just fill out and mail coupon below.

Typical Physical Properties of Forticel

Flow temperature	(°C.) (A.S.T.M.)	D569-48	167—178
Specific gravity		D176-42T	1.18—1.21
Tensile properties:	Yield (p.s.i.)	D638-52T	3380—5020
	Break (p.s.i.)	D638-52T	3470—5240
	Elongation (%)	D638-52T	58—66
Flexural properties:	Flexural strength (p.s.i. at break)	D790-49T	8400—9500
	Flexural modulus (10^5 p.s.i.)	D790-49T	0.23—0.30
Rockwell Hardness:	(R scale)	D785-51	82—84
Izod Impact	(ft. lb./in. notch)	D256-43T	2.7—11.0
Heat distortion	(°C.)	D648-45T	59—78
Water absorption—	% Sol. lost	D570-42	0.08—0.98
	% Moisture gain	D570-42	1.6—1.8
	% Water absorption	D570-42	1.6—1.8

Celanese* plastics

*Reg. U. S. Pat. Off.

Celanese Corporation of America, Plastics Division,
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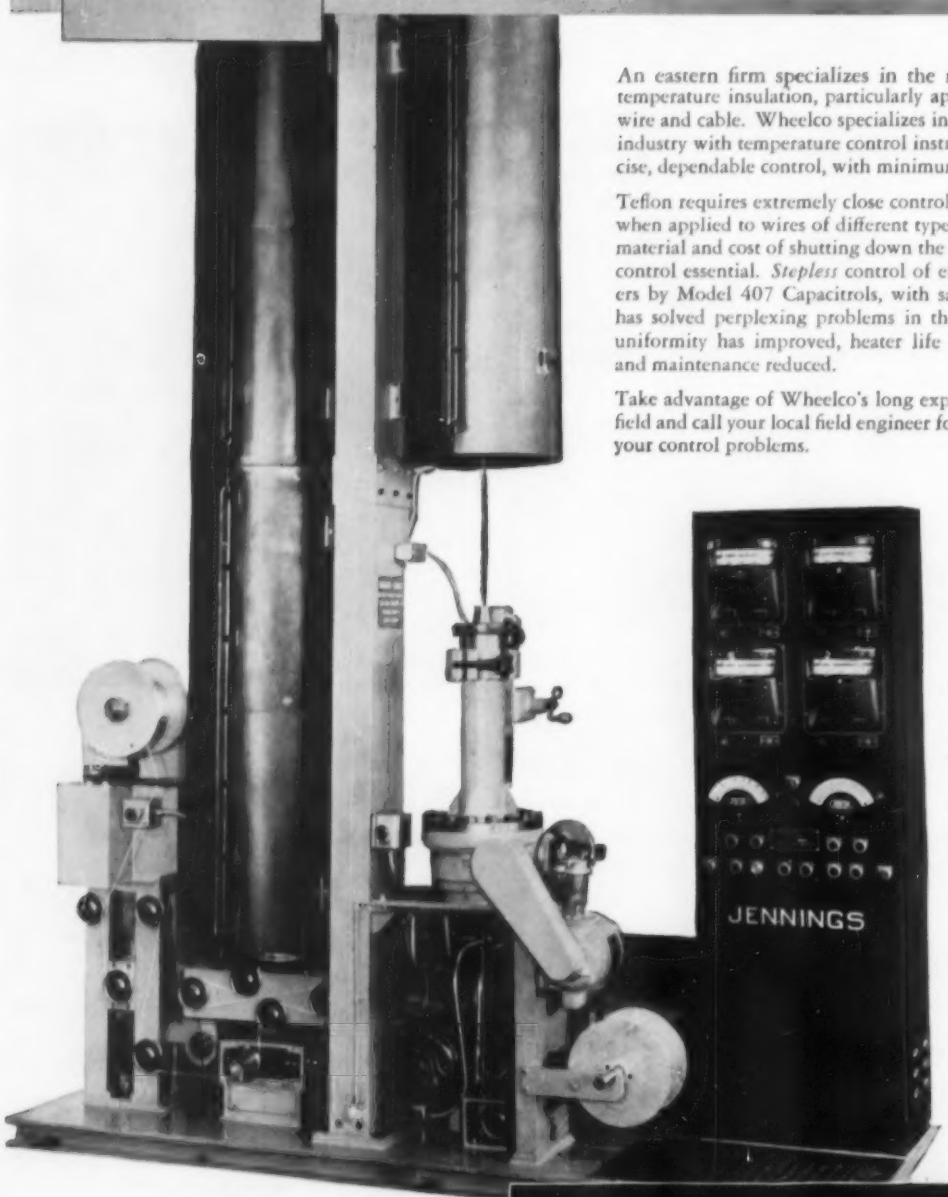
Model 407 Capacitrol controls Teflon extrusion — exactly!

MORE THAN 80% of the plastic molders in the New York area have expressed their preference for Wheelco Instruments. Wherever plastic machines are used, Wheelco furnishes precise, dependable control at low cost.

An eastern firm specializes in the manufacture of high temperature insulation, particularly application of Teflon to wire and cable. Wheelco specializes in supplying the plastics industry with temperature control instruments that offer precise, dependable control, with minimum maintenance.

Teflon requires extremely close control, at high temperatures when applied to wires of different types. Expense of the raw material and cost of shutting down the extruder make perfect control essential. *Stepless* control of electric resistance heaters by Model 407 Capacitrols, with saturable core reactors, has solved perplexing problems in this operation. Product uniformity has improved, heater life has been lengthened, and maintenance reduced.

Take advantage of Wheelco's long experience in the plastics field and call your local field engineer for assistance in solving your control problems.



Model 407 Capacitrol controls this Jennings extruder, maintaining operating temperatures at exactly 800 F. Heater life is lengthened and maintenance reduced.

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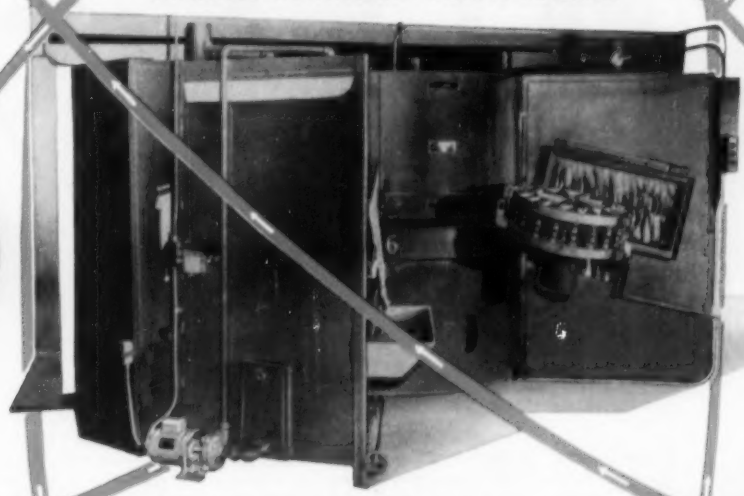

This machine, requiring only one operator, can produce as many as 1620 articles per hour at an obviously low labor cost per article.

It consists of six spindles which revolve around a central shaft. Each spindle carries a multiple cavity mold and has its own rotational movement independent of the central shaft movement. The plastisol goes through the complete progressive stages of gelling, fusing, and cooling into its final resilient form in a variable cycle of 12 to 20 minutes.

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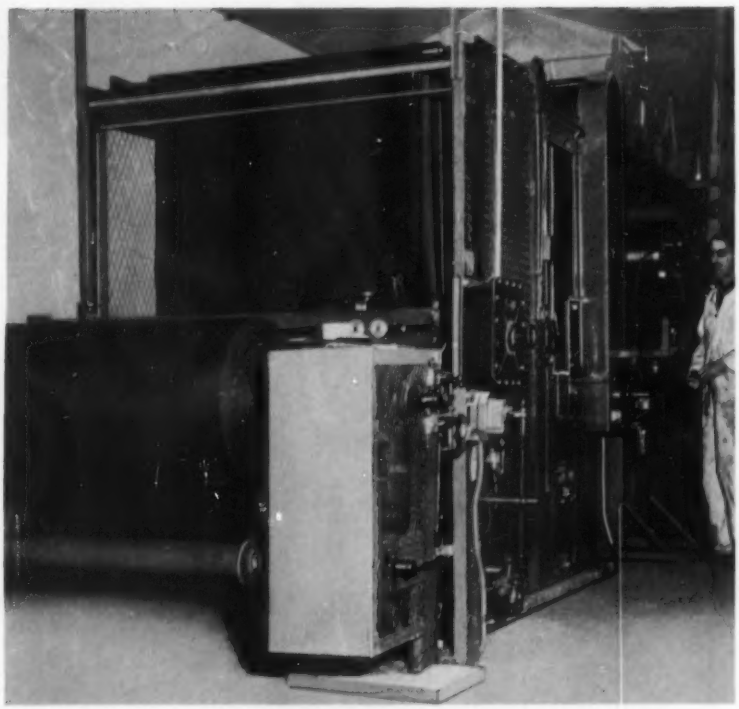

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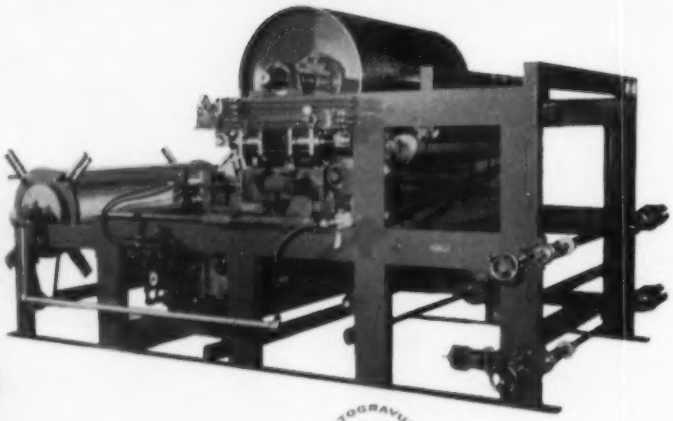

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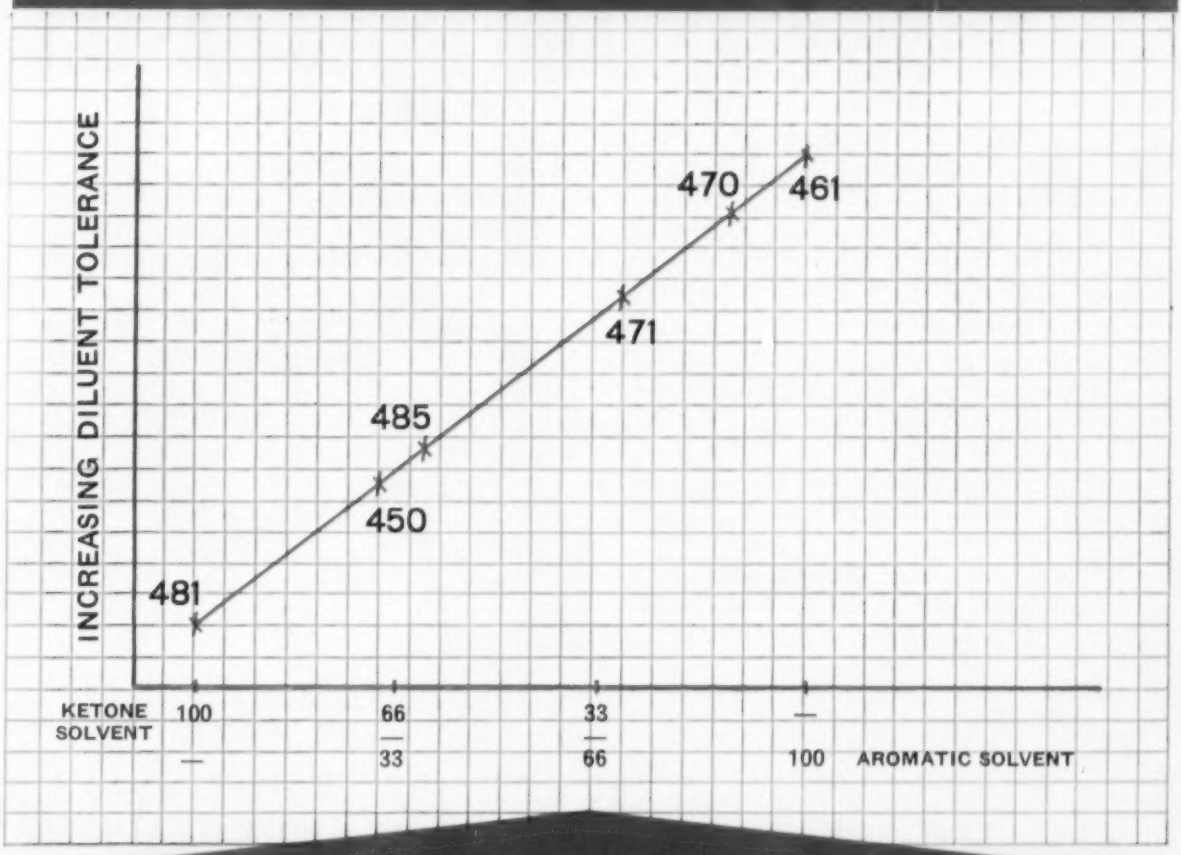

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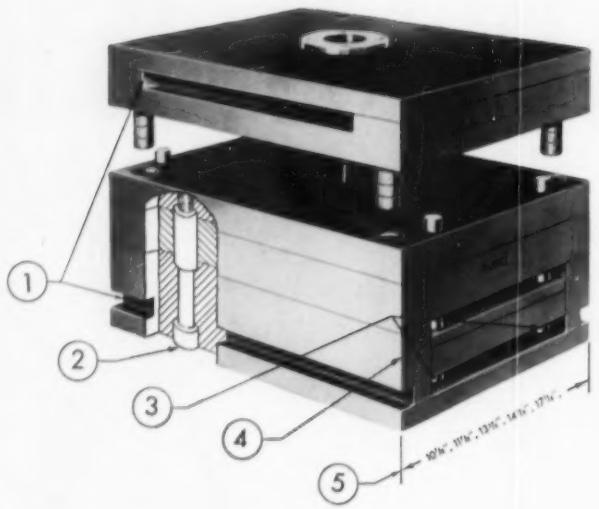

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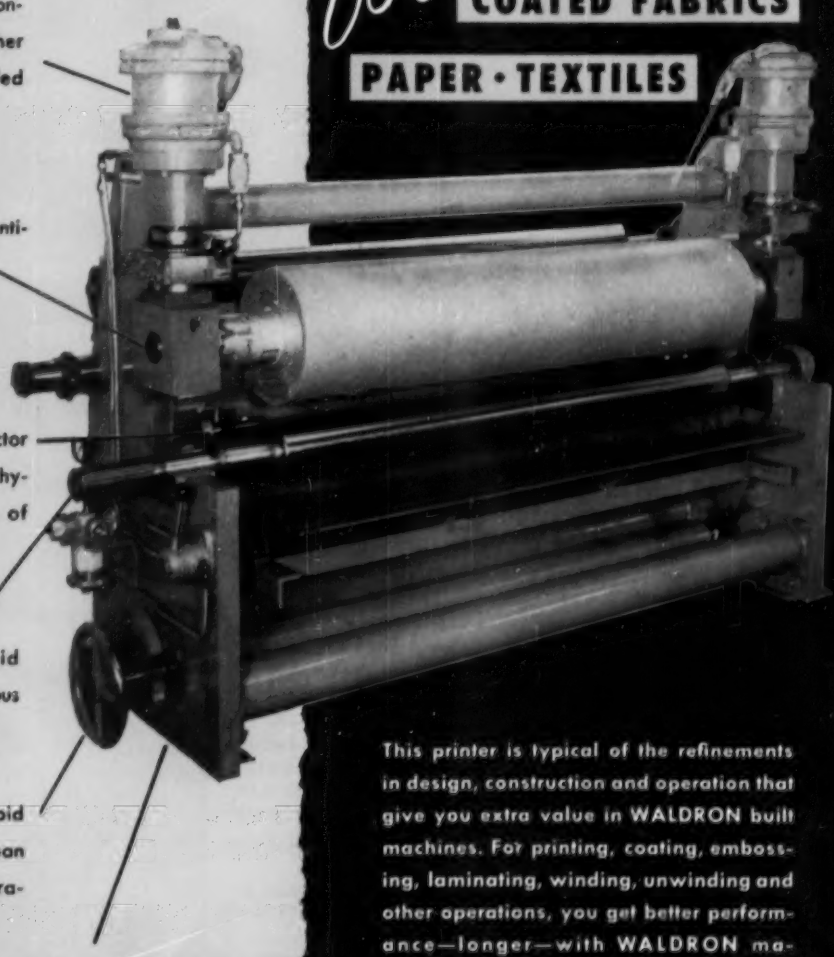

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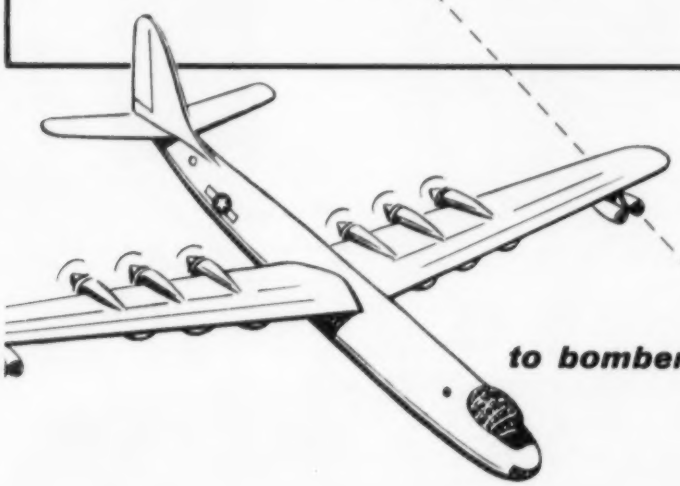

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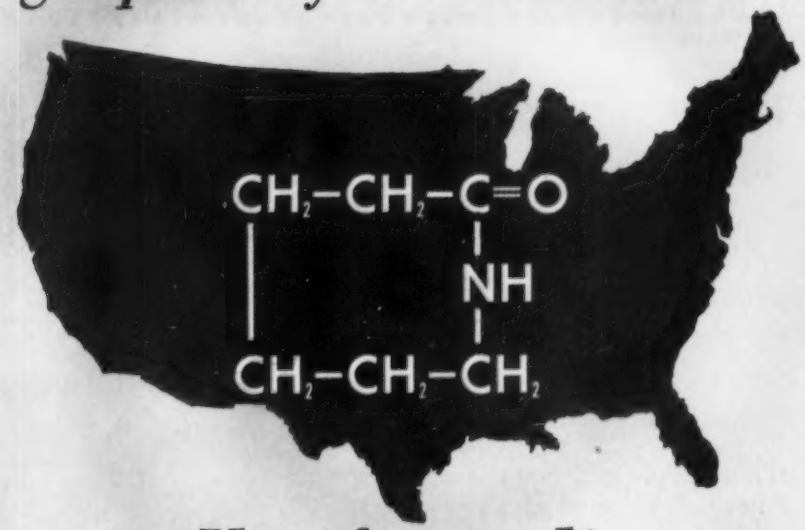

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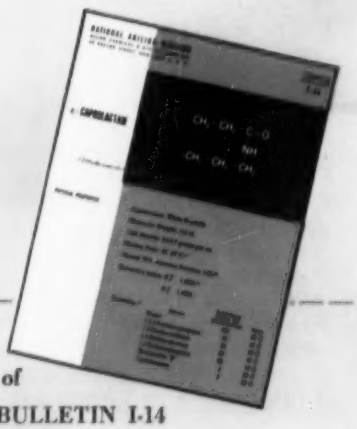

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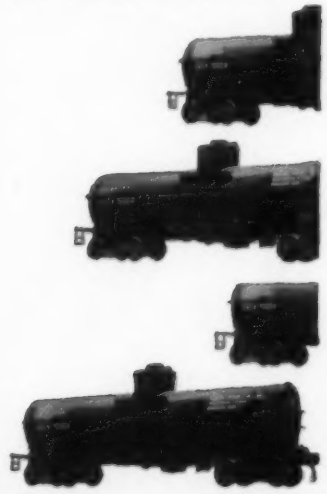

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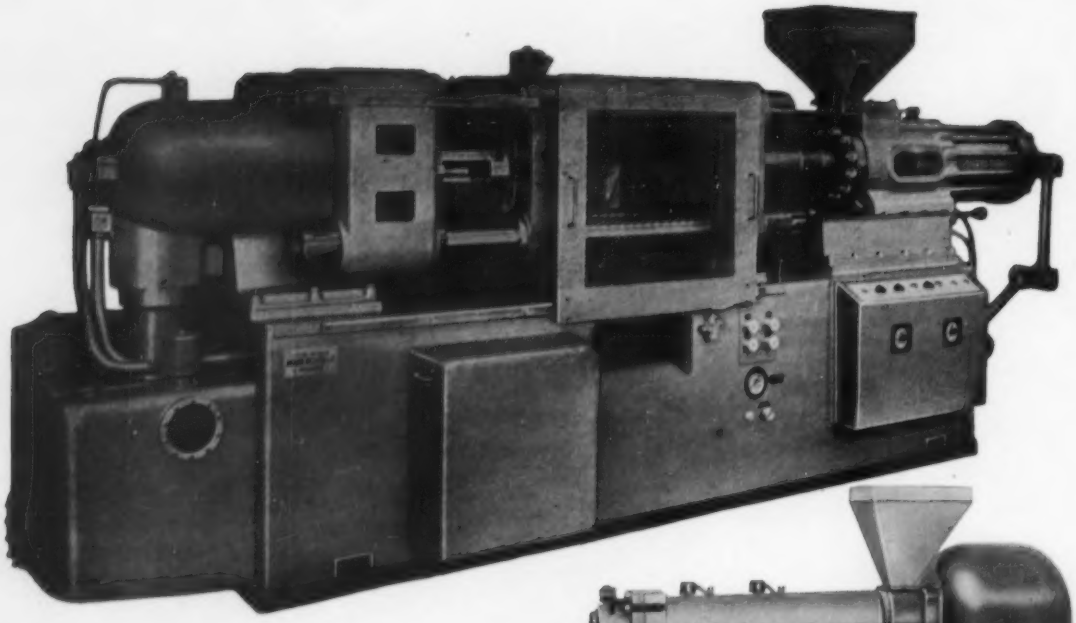

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Negri Bossi also makes a full line of extruder take-off equipment.

VACUUM FORMERS—Here is something *really* sensational! Negri Bossi introduces vacuum formers with patented movable, variable infra-red heaters that concentrate heat where it is most needed, assuring constant cross-sections throughout formed pieces and permitting extremely deep draws. Negri Bossi also manufactures a low-cost model for laboratory and test-run use, and a high-output machine with two 25⅝" by 35⅝" stations.

Write for detailed information on machinery made by Negri Bossi, one of the world's largest manufacturers of plastics processing equipment.

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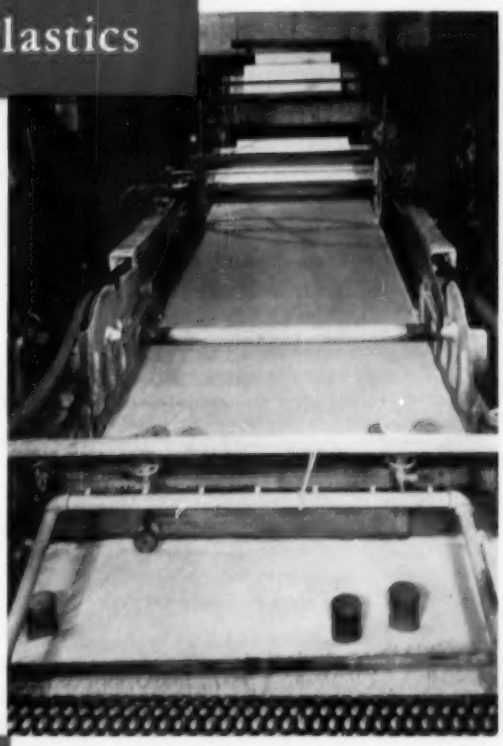
We have discontinued completely the manufacture of blotting and related types of absorbent papers.

This new program of concentration on a single product will be reflected in the form of superior service to our present customers and others whom it is our desire to serve.

We offer expert consulting service, without obligation, in the development of Saturating Papers. Through the research facilities of our well-staffed laboratory, we can be of special help in the development of striking new colors.

Inquiries are cordially invited.



Saturating paper in an endless stream flows from this modern paper machine in the Wrenn mill.

THE WRENN PAPER COMPANY
MIDDLETOWN, OHIO

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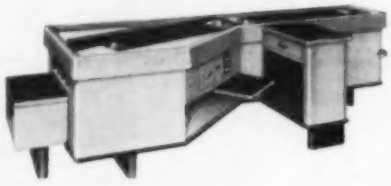
DELIVERY TRUCK—
stronger, lighter, longer lasting than a metal body.

PRODUCTS ARE 

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MADE OF FIBERGLAS-

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Great Strength with Light Weight
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Greater Design Versatility
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Different products, for different end-uses. But all of these products have one thing in common—they are successful because they are made with Fiberglas*-reinforced plastic.

Through Fiberglas reinforcement, plastics become materials capable of performing a broad range of tasks!

Fiberglas adds amazing physical properties to plastics—by designing to take advantage of these properties your product can benefit and compete on an economic basis with products made with less efficient materials.

Investigate how these properties can contribute to your product. We'll be more than glad to help you find the answer. Write to Owens-Corning Fiberglas Corp., Textile Products Division, Dept. 125-F, 598 Madison Ave., New York 22, N. Y.

It's amazing the difference Fiberglas makes

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*T. M. Reg. O-CF Corp.

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Here's a brand new product that will help you increase production on your present extrusion and injection molding machines. It's the new Chromalox Electric Heater Band. Designed to fit heating barrels of most diameters, Chromalox Heater Bands step up barrel temperatures . . . leading the way to faster molding cycles and faster extruding.

The new style Chromalox strip heater gives maximum heating surface in contact with the barrel. The new special alloy clamping band keeps the heater in firm, even contact with the barrel at all temperatures . . . resulting in more efficient heat transfer. This means added heater life.

What's more, temperature ranges have been extended to 700° on the barrel. Coupled with increased heater efficiency and service life, this lets you shorten work cycles, increase the capacity of your machines.

Check into the possibilities of upgrading the performance of your present machines by converting to the new Chromalox Heater Bank. Contact your Chromalox representative . . . he's the man with the electrical answer to all your heating problems.

For more information on the new Chromalox Heater Band, write for a copy of Bulletin SP-2508.

Edwin L. Wiegand Company

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CREATES NEW DESIGNS—
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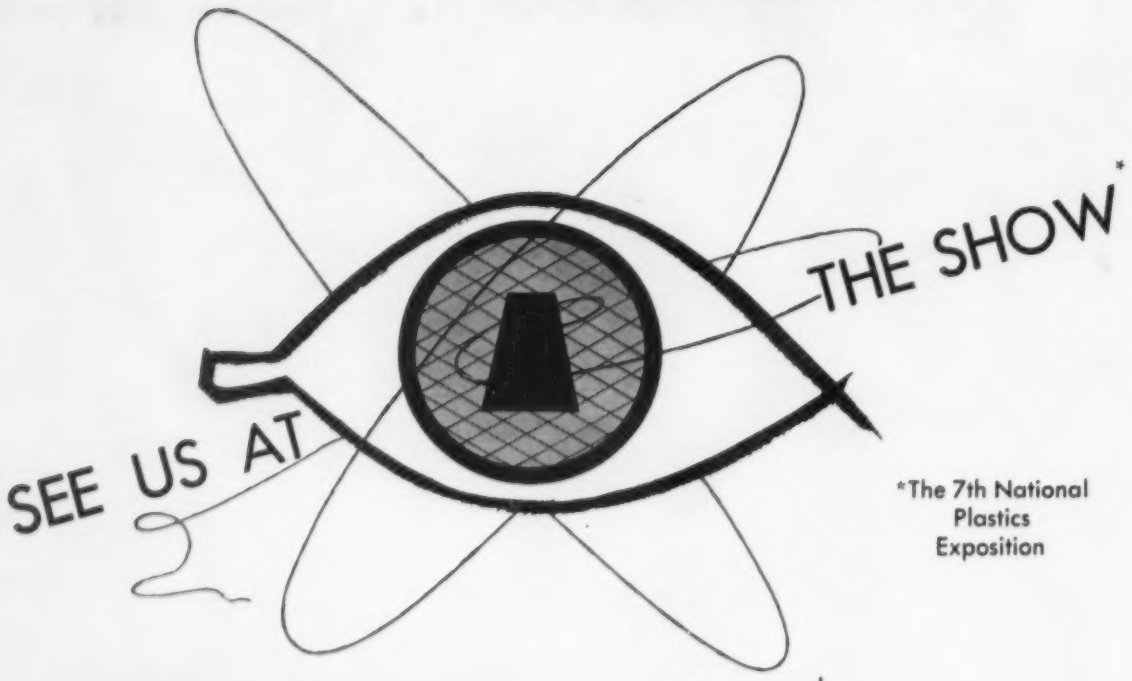

*The 7th National Plastics Exposition

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Give your product the sparkle of a brilliant metallic finish with CHROMEFLEX laminated metallic plastic sheeting. CHROMEFLEX is non-corrosive, non-abrasive, fade-proof and weather-resistant, with unusually high tensile strength. Gold, silver or metallic colors in widths up to 56" Die-cut to specifications of size or shape. Used for appliance trim, shoe and accessory fabrics, reflectors, automotive and airplane interiors. For information write.

High Vacuum Metals, Inc., 40 Worth St., New York 13, N. Y

CHROMEFLEX "Mylar"* YARN

Will withstand temperatures up to 400°F in textile dyeing and finishing, far exceeding the range of ordinary metallic yarns. CHROMEFLEX yarn is extremely brilliant, non-tarnishing, and has a wonderful softness of hand. For information write:

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The Hy-Sil Manufacturing Company, which is the parent company of this group, celebrates its 50th anniversary this year; it was the first company in this country to metallize flexible plastic films. Hy-Sil specializes in custom commercial plating with silver and aluminum on cellophane, cellulose acetate, polystyrene, mylar and rigid vinyl. Under high vacuum, the metal is deposited on the films in widths up to 60". For information write:

Hy-Sil Manufacturing Co., Plastic Division, Revere, Mass.

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Some of the companies that have used **CHROMEFLEX** products:

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SCHICK RAZOR
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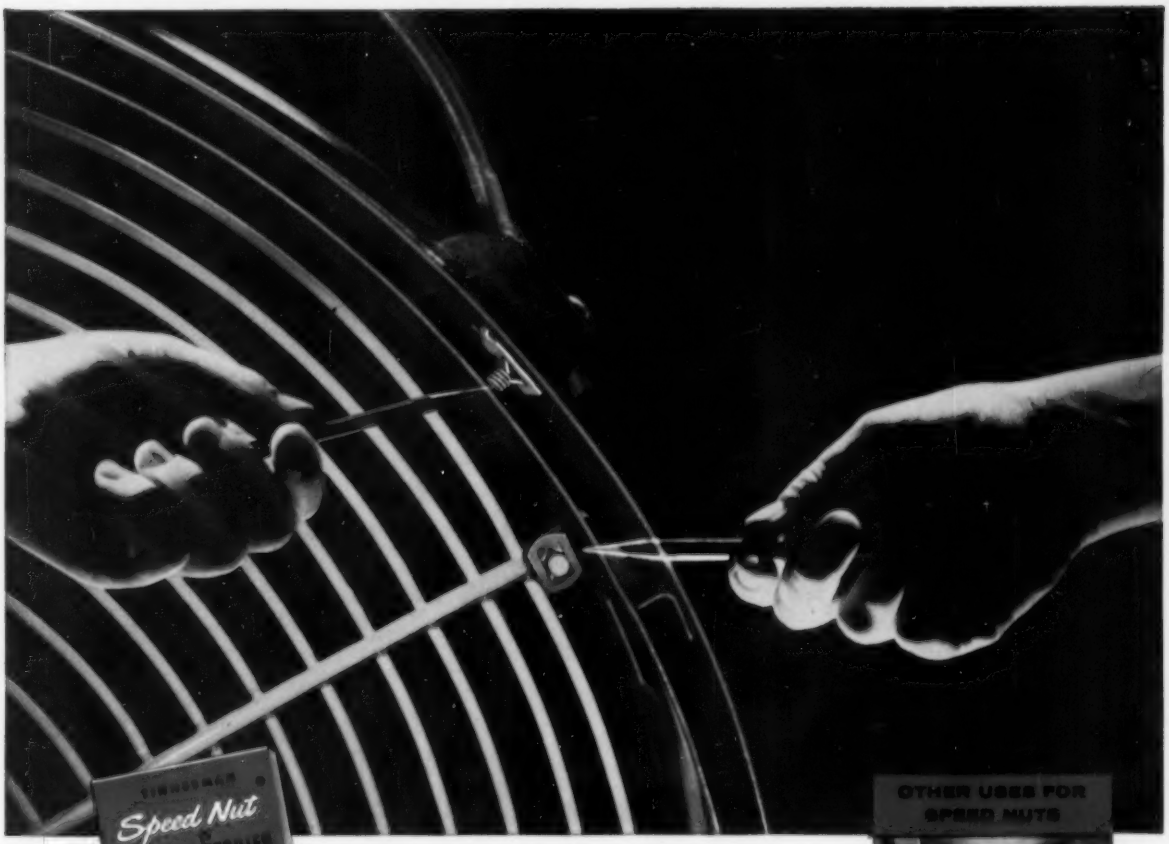

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Two "J" Type SPEED NUTS make a lightning-fast, vibrationproof attachment of carrying handle to fan housing. Three Push-On SPEED NUTS firmly secure the grill to the housing.

Twelve parts were eliminated to bring about a 37% cost saving; total assembly time has been reduced from 25 to 18 minutes to effect a 28% time saving. The elimination of a spot welding operation and a punch press also resulted in a better use of over 400 square feet of floor space!

Your Tinnerman representative can offer you over 8,000 different shapes and sizes of SPEED NUT brand fasteners to produce similar fastening savings in your product assemblies. Call him, or write for your free copy of "SPEED NUT Savings Stories."

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Canada: Dominion Fasteners, Limited, Hamilton, Ontario. *Great Britain:* Simmonds Aerocessories, Limited, Treforest, Wales. *France:* Aerocessoires Simmonds, S. A., 7 rue Henri Barbusse, Levallois (Seine). *Germany:* Hans Sickinger GmbH "MECANO", Lemgo-i-Lippe.

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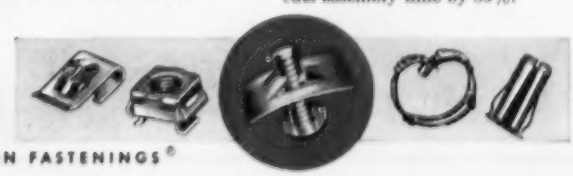
Jet-convector heater manufacturer uses "U" and "J" type SPEED NUTS, reduces assembly time by 50%.

"U" and "J" type SPEED NUTS designed into new gas range gain 50% assembly time saving.

On this ceiling light, special SPEED NUT replaces 3 parts, cuts assembly time by 80%!

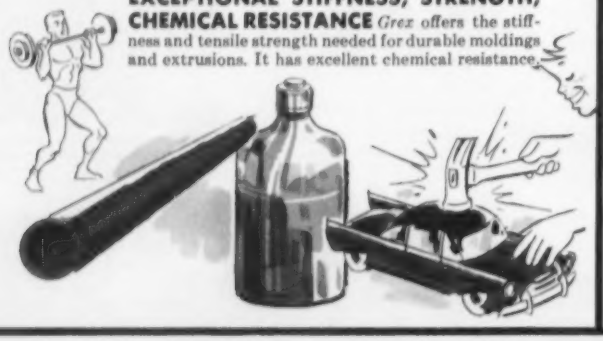
TINNERMAN Speed Nuts®

FASTEST THING IN FASTENINGS®

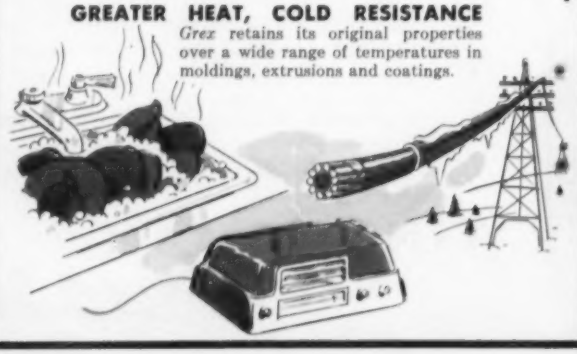


What do you

EXCEPTIONAL STIFFNESS, STRENGTH, CHEMICAL RESISTANCE *Grex* offers the stiffness and tensile strength needed for durable moldings and extrusions. It has excellent chemical resistance.



GREATER HEAT, COLD RESISTANCE *Grex* retains its original properties over a wide range of temperatures in moldings, extrusions and coatings.



make of this?

This is *Grex* linear polyethylene—first member of the great new family of *Grex* polyolefins.

Grex linear polyethylene opens broad new horizons for the plastics industry. It combines the traditional qualities of popular, conventional polyethylene with properties obtainable until now only in costlier, hard-to-work materials.

It has exceptional stiffness, superior tensile strength and good surface hardness. It will withstand boiling temperatures—even steam sterilization—and hard freezing. It bonds easily and securely. It colors readily. It is an excellent moisture-vapor barrier.

A hundred possibilities have been suggested for its use. Uncounted new applications will be developed for this remarkable resin and for its companion polyolefins.

To meet the vast demand for this versatile resin, Polymer Chemicals Division, W. R. Grace & Co., is now constructing a multimillion dollar chemical plant at Baton Rouge, Louisiana. Commercial production is scheduled for mid-'57. A fully-equipped applications research laboratory is already in operation. Evaluation samples will soon be available from our semi-works plant.

Meanwhile, *Grex* technical service experts will gladly cooperate with molders and extruders who express an early interest in this revolutionary new resin.

GREX*

THE PLASTICS RESIN OF TOMORROW

POLYMER CHEMICALS DIVISION

W. R. GRACE & CO.

3 Hanover Square, New York 4, N. Y.

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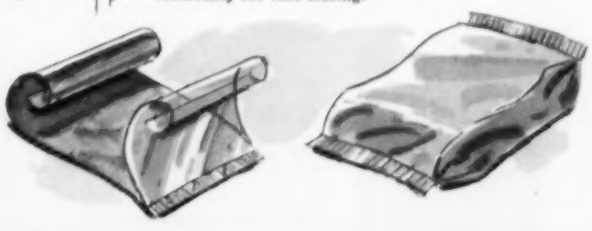
MORE EFFECTIVE VAPOR BARRIER

Grex provides a measurably more effective moisture-vapor barrier than conventional polyethylene for packaging and insulating uses.

READILY HEAT SEALABLE, TOO

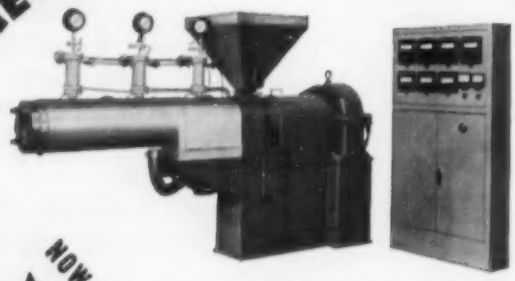
Whether in self-sustaining film or laminated to papers and foils, *Grex* provides good "slip" for fast fabricating and good heat sealability for fast closing.



extruders by *Egan*

From 2" Thru 8" with screw lengths of 16 or 20 Diameters. • Hard corrosion resistant liners. • Heavy duty thrust and radial bearings with force feed lubrication. • Completely prewired temperature control cabinet. • Screw speed tachometer. • Precision ground screws. • Large feed hopper with sight glass and cut-off slide. Complete installations for film, sheet, pipe, shapes.

NEW! Automatic Vapor Pressure Cooling*



*Patent Applied For

See it at the S. P. I. SHOW
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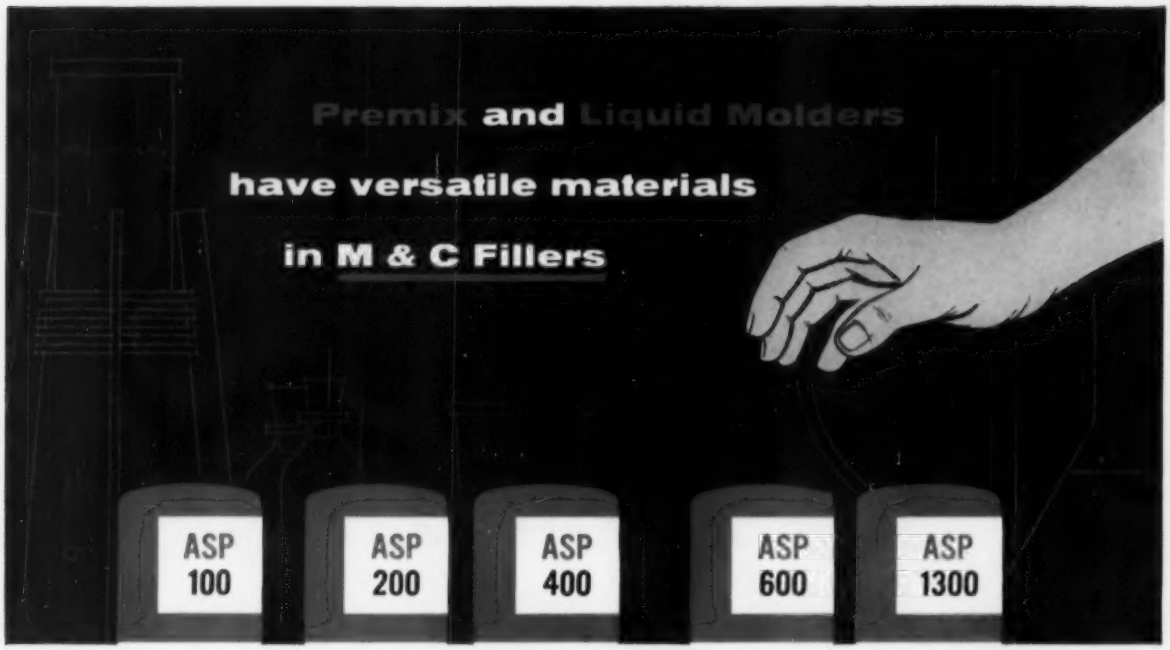
Premix and Liquid Molders have versatile materials in M & C Fillers



Edgar ASP Mineral Fillers (Aluminum Silicate Pigments) offer many desirable qualities to the fields of Premix ("Gunk") and Liquid Molding . . . give to molders and compound formulators improved properties, better finish, cost reduction.

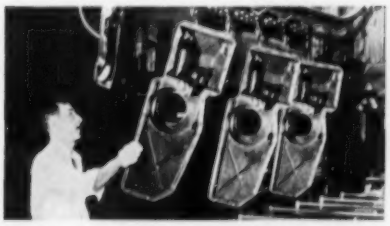
In Premix Operations—Put to work in gunk molding, ASPs are major aids to maintaining a homogeneous mixture during molding, with a dryness and nontackiness that mean great handling ease. Equally vital assists include long pot life; excellent physical and electrical properties.

In Liquid Molding, ASPs exhibit high opacity and hiding power; excellent suspension properties; long pot life; good flow properties, with thixotropy that permits fast mold closure and rapid mold fill-out, without excess runout.

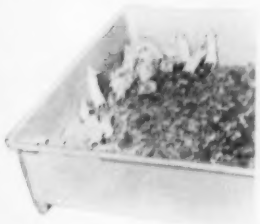
Common To Both Operations are smooth, dense surface; high resistance to water, chemicals, weathering; low filler price.

Which Is Best? There's a family of ASPs, as the illustration shows. One is best for producing optimum values for specific properties. Use the coupon . . . we'll work out the details together.

ASP Fillers at work!



ASP application in premix. This complex 5.6 lb. mass-produced automotive heater part demands the utmost in flow performance. (Photo courtesy Woodall Industries, Inc., Detroit, Mich.)



In this biological tray, application values of ASP filler include: smooth, dense impervious surface that can be washed and sterilized, and is unaffected by acids in animal excreta. (Photo courtesy Molded Fiber Glass Tray Co., Linesville, Pa.)

Edgar **EDGAR PRODUCTS** *from . . .*

M/C **MINERALS & CHEMICALS CORPORATION OF AMERICA**
55 ESSEX TURNPIKE, MENLO PARK, N. J.

SERVING THE PLASTICS INDUSTRY FROM WAREHOUSE STOCKS IN 30 CITIES

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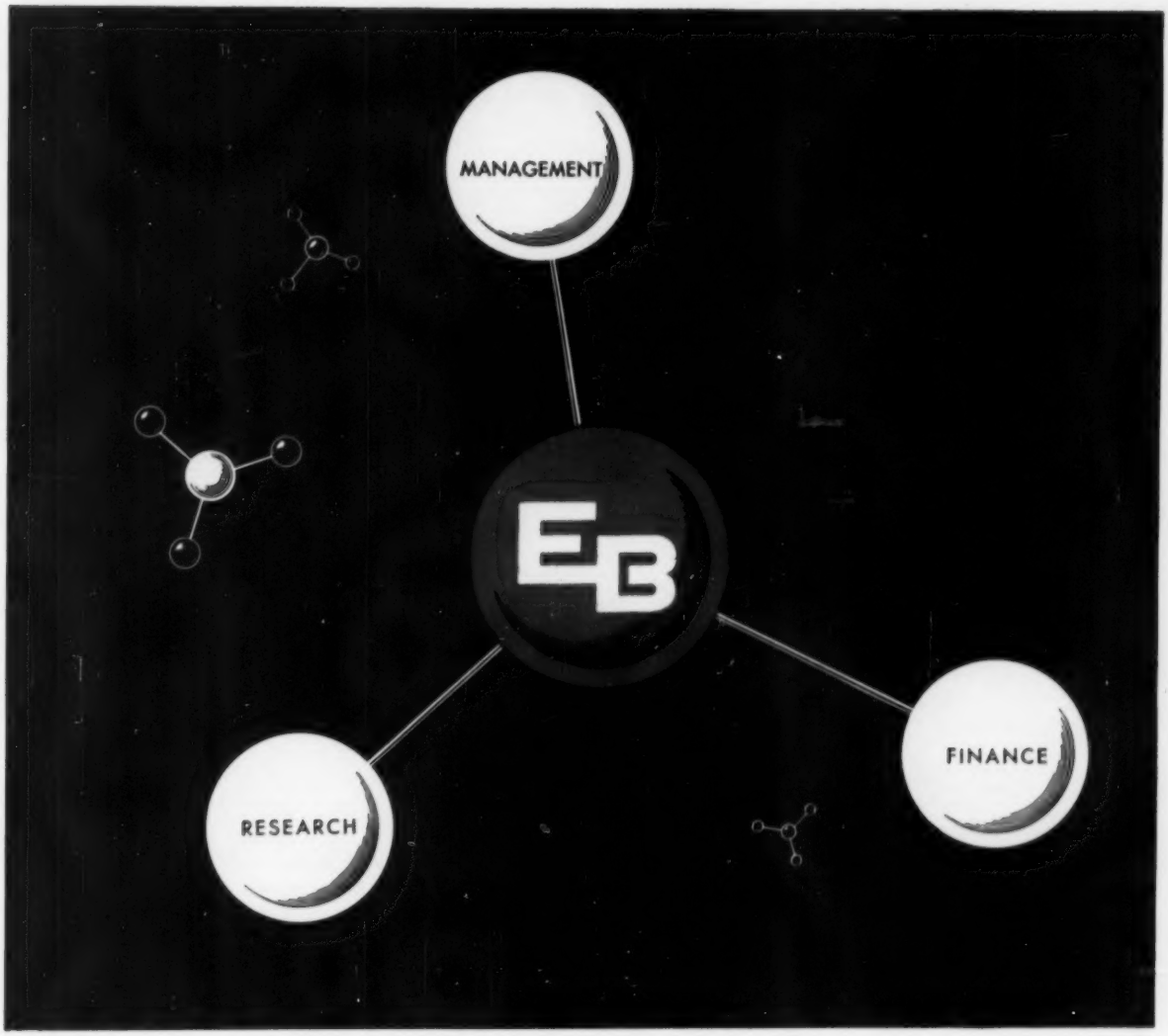

from these three . . . comes progress!

You are cordially invited to visit the Escambia Bay exhibit (Booth #1220) at the National Plastics Exposition, New York Coliseum, June 11-15, 1956.

A successful company, like a successful product, is the result of sound management, adequate financing, and intensive research. Escambia Bay Chemical Corporation—a new "element" in plastics raw materials—has applied these basic factors to their fullest in bringing nitrogen fertilizer materials on stream in a matter of months.

Progress is continuing rapidly with the construction of a 30 million pound polyvinyl chloride resin plant at the site near Pensacola, Florida, to be in production before the end of this year.

With emphasis on research and development, quality control, product uniformity and technical service, Escambia Bay has plans for the future in keeping with the progress made to date.

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"Customer Savings" is the Reason 1955 was the Best Year in Setko's 20-Year History

Set Screw News

Set Screw & Mfg. Co.

We specialize in Solving Puzzling Set Screw Problems

Issue No. 5 | **Bartlett, Illinois (Chicago Suburb)** | **Plastics Edition**

Free Demonstration Shows How to Cut Costs with SETKO HOPPER-FED* Headless Set Screws

How Rogan Bros. uses Setko Method of Hopper-Feeding Set Screws in its Automation of Drilling, Tapping and Inserting

Above is a typical Setko Hopper-Feeding Set Screw installation, showing its use with special equipment designed and used by Rogan Bros., Skokie, Ill., to drill and tap plastic knobs and insert set screws automatically in sequence. With this Setko method only one machine is required in place of three, and half the number of operators. This is one of many Setko Hopper-Feeding applications.

*Patent No. 2,638,945 Other Patents Pending

Available in Either of these Popular Styles with any Type Point

We Specialize in Solving Puzzling Set Screw Problems *by originating new developments such as these (Pat. Pending):*

Zip-Grip Self-Locking
Flush-Lok Self-Locking
Nu-Cup (increased holding power)
Fluted Self-Tapping
Self-Tapping Slotted Set and Fastening Screws
Point-Lok (for double screw application)
and many others
Check coupon for Bulletins

1429

Latest of Setko's many innovations is the new Hopper-Fed Set Screw, introducing an entirely new, exclusive method of application and offering—

Many Unusual Advantages

- Requires about one-tenth the time of former methods of headless set screw application as proven by actual test.
- Automatically inspects diameter and rejects misfits.
- Works equally well with all metals and with plastics.
- Takes less floor space and permits smaller set-screw inventory.
- Can be used for practically any headless set screw application, including the new Setko Self-Tapping.
- Reduces to minimum the problems of the "human" element, such as floor loss and cross-threading.
- Makes possible faster delivery.
- Can be obtained with any style point.

Operation

A step further toward ever-growing "automation"! The new, specially designed Setko Hopper-Fed Set Screws are mechanically fed from a vibrating hopper, down through a tube, and automatically positioned for driving. (See illustration at left.)

Mechanism and Demonstration

This special mechanism has been designed by Set Screw & Mfg. Co. exclusively for users of its new Hopper-Fed Headless Set Screws . . . and for its customers' protection, the mechanism and screws will be sold only to work in conjunction with each other. To show the many advantages of this new process, demonstrations of the hopper mechanism and screws are being made at the Set Screw & Mfg. Co. plant and arrangements will be made for anyone who wishes to come and see the demonstration.

Get Full Details

Learn *all* the time-and-money-saving advantages that the new Setko Hopper-Fed Headless Set Screws can bring you; find out how easy it is to have a demonstration. Don't bother to write a letter or even a postcard. Simply . . .

SET SCREW & MFG. CO., 54 Main St., Bartlett, Ill.

Without any cost or obligation on my part, please send me full particulars about the new Setko Hopper-Fed Headless Set Screws. (Check next line if you would like a demonstration.)

☐ I would like to have a demonstration of the special operating mechanism at your plant in Bartlett, Illinois (Chicago suburb). Please advise me how this can be arranged.

☐ Please send bulletins on..... ☐ Please send complete catalog .....

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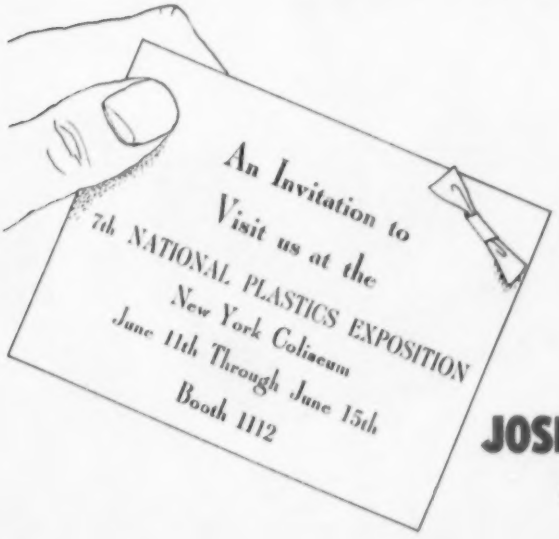

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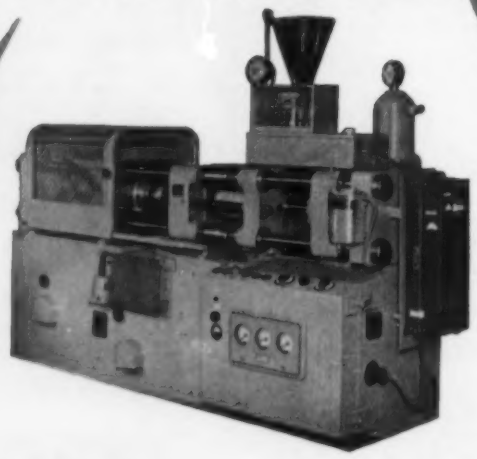

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in 34 countries recognized that the fully automatic run of BATTENFELD injection moulding machines from ¼-50 ozs. ensures most economical production

BATTENFELD MASCHINENFABRIK **MEINERZHAGEN I. WESTF.**
Germany

U.S.I. POLYETHYLENE PROCESSING TIPS

Vol. 1, No. 3

Reduce Warpage in Injection Molding

Injection molded polyethylene articles frequently have a tendency to warp — especially if they are large and flat. While this is not serious in many cases, warpage of certain items such as container covers and drainboards presents a definite and sometimes difficult problem.

How can warpage be corrected? There is no single clear-cut solution to all cases. The problem can be solved by reducing the internal stresses that are set up in a molded part during cooling, and this may be done by adjusting mold conditions, changing to another resin, redesigning the mold, or a combination of these changes.

Molding Conditions Can Be Adjusted

Pressure should be held as low as possible. This allows some of the internal stresses to be relieved. Of course pressure must be kept high enough to avoid short shots.

Stock temperatures should be kept high to kill the elastic memory of the resin. This avoids those stresses that might otherwise be created by elastic memory.

Molds should be kept warm. Most of the internal stresses that cause warpage come from uneven cooling. By cooling slowly this effect is minimized.

Mold should be filled as rapidly as possible so that the entire part can be cooled at about the same rate.

OPERATING CONDITIONS FOR MINIMUM WARP

Molding Condition	Min. Warp
Pressure	low
Mold Temp.	balanced and warm
Stock Temp.	high
Gating Temp.	low
Injection Speed	high
M. I. of Resin	high

Mold Design For Minimum Warpage

Mold cooling should be concentrated around the gating where resin temperature is highest. With more cooling at the hottest point, temperature of the entire part can be reduced evenly with a minimum of internal stress.

Other mold design features are important too, especially the location of the sprue. The many other factors involved cannot be described here, but U.S.I. Technical Service personnel will be glad to discuss any individual situation.

Proper Resin Selection Can Decrease Warpage

Higher stock temperature and lower pressure can solve warpage problems, but they can create problems too, such as reduction of production rate. This can be compensated for by choosing resins with higher flow characteristics, such as PETROTHENE® 202 (M.I. = 22) or PETROTHENE® 203 (M.I. = 8).

These resins flow faster at lower pressures, so the lower pressure can be used without taking a production penalty. And the elastic memory of these resins can be killed at lower temperatures, so the machine can be operated with lower barrel temperature.

How much effect does a higher flow resin have on molding pressure and resin temperature? These rules of thumb apply in most cases.

1. Injection pressure can be reduced by approximately 25% when the resin melt index is doubled; assuming, of course, the same mold fill, cycle time and injection pressure.

Example:	M. I.	Pressure
Original Resin	2	1,000 psi
Other Resins	4	750 psi
	8	560 psi

Injection temperatures can be reduced by approximately 70°F when the resin melt index is doubled. This assumes the same fill, cycle time and injection pressure.

Example:	M. I.	Temperature
Original Resin	2	500°F.
Other Resins	4	430°F.
	8	360°F.

U.S.I. Offers Technical Assistance

The combination of machine conditions, mold design, and resin selection described above can result in a product with minimum warpage. But this combination may not be the best for optimum production rate, shrinkage, mold release, stress crack resistance, etc.

These other factors will be discussed in more detail, in future articles in this series, but if you have a particular problem now, why don't you call on U.S.I. now. Our Technical Service personnel will be glad to work with you toward finding a solution.

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Mexico:	Huber de Mexico S.A., Comte 85, N. Anzures, Mexico D.F.
Venezuela, Columbia:	Venufix C.A. Avenida Victoria, Apartado 3737, Caracas.

NEW, DIFFERENT, DEFINITELY SUPERIOR...

PITTSBURGH 508 PREFORM ROVING

All of our molding customers who have tried Pittsburgh's new #508 roving report excellent results. That's because PPG #508 really "outperforms" other known types of roving in producing consistently better preforms.

PPG #508 Preform Roving is definitely superior because it has been treated by a special sizing process to insure better chemical and mechanical bond between glass fibers and molding resin. Results: consistently high quality moldings, lower scrap rate, faster preforming.

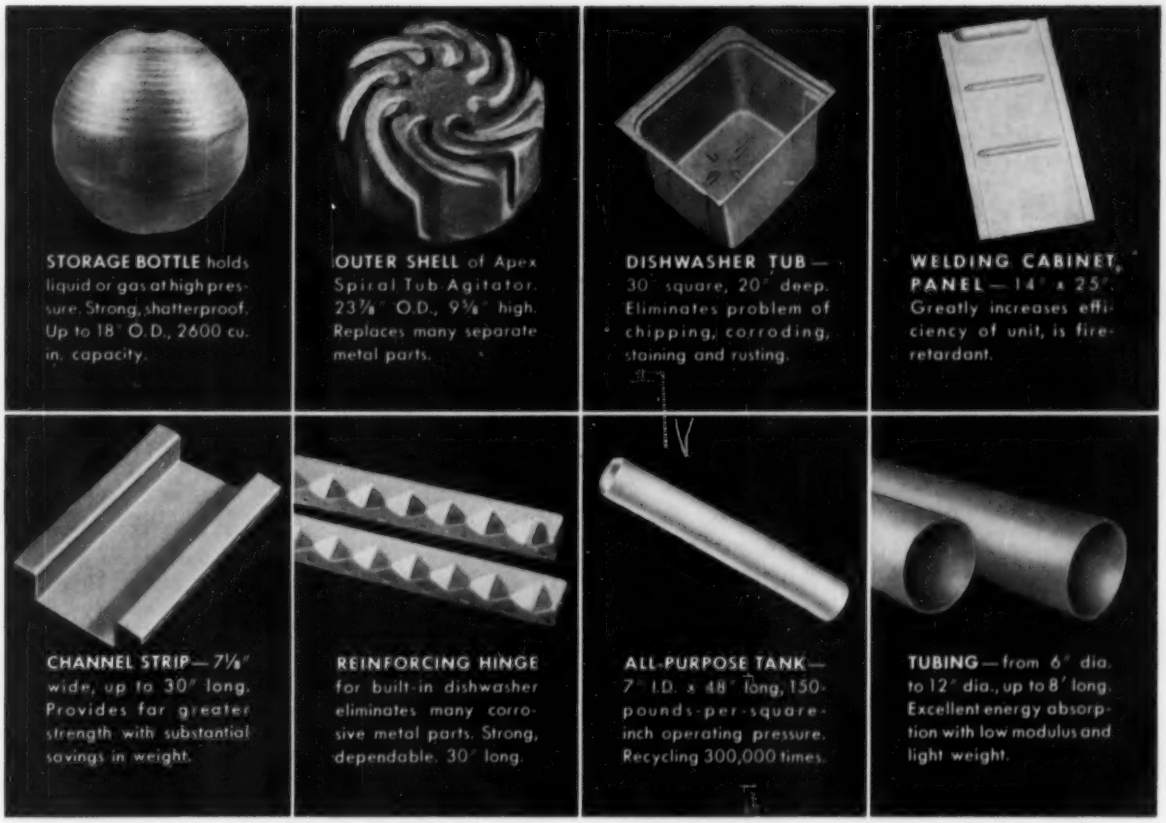
Check out PPG's new 508 Preform Roving on your own molding jobs and see the difference. You can get complete information on standard packages and available sizes by simply contacting our executive offices or our district sales offices in Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, New York, Philadelphia, St. Louis or Los Angeles. Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.

FIBER GLASS PPG PAINTS · GLASS · CHEMICALS · BRUSHES · PLASTICS

PITTSBURGH PLATE GLASS COMPANY

ANNOUNCEMENT

The coming Modern Plastics Encyclopedia Issue for 1956 is now open for advertising space reservations. Copy deadline is June 28. Publication date is September, 1956. For rates and other details write Advertising Department, Modern Plastics, 575 Madison Ave., New York City 22, N.Y.



STORAGE BOTTLE holds liquid or gas at high pressure. Strong, shatterproof. Up to 18" O.D., 2600 cu. in. capacity.

OUTER SHELL of Apex Spiral Tub Agitator. 23⅞" O.D., 9⅝" high. Replaces many separate metal parts.

DISHWASHER TUB—30" square, 20" deep. Eliminates problem of chipping, corroding, staining and rusting.

WELDING CABINET PANEL—14" x 25". Greatly increases efficiency of unit, is fire-retardant.

CHANNEL STRIP—7⅛" wide, up to 30" long. Provides far greater strength with substantial savings in weight.

REINFORCING HINGE for built-in dishwasher eliminates many corrosive metal parts. Strong, dependable. 30" long.

ALL-PURPOSE TANK—7" I.D. x 48" long, 150-pounds-per-square-inch operating pressure. Recycling 300,000 times.

TUBING—from 6" dia. to 12" dia., up to 8' long. Excellent energy absorption with low modulus and light weight.

Save weight, save time, save handling with APEX Custom-Molded Fibre-Glass Parts!

Here's the perfect solution to production problems involving large parts that are too heavy, too costly, and require excessive handling and assembly time —change to Apex Fibre-Glass parts!

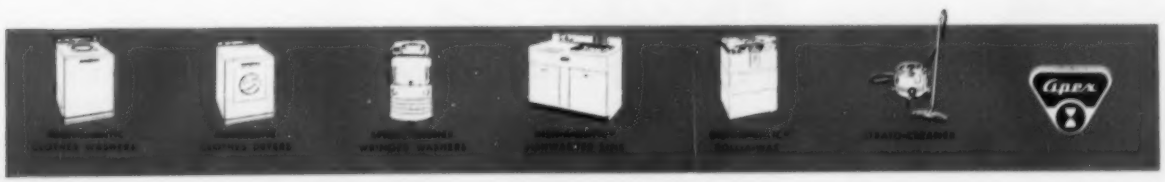
Apex has helped many manufacturers gain important production advantages and substantial savings since 1947, when it pioneered in the use of Fibre-Glass reinforced polyester thermosetting resins for commercial-product applications. What's more, Apex has the experience and facilities to produce a wide variety of large-size Fibre-Glass pieces —a few are shown above—using pre-forms, mat or glass cloth on low-pressure matched metal molds, for tubs, cases and containers, tubes, tanks, spheres.

Write for FREE folder!

Whether or not you now use large-size Fibre-Glass parts, Apex invites your research, development and production inquiries. Write today for descriptive folder and full information on our services.

THE APEX ELECTRICAL MFG. CO. ***FIBRE-GLASS MOLDING DIVISION***

1070 EAST 152ND STREET **PHONE: ULSTER 1-4200** **CLEVELAND 10, OHIO**



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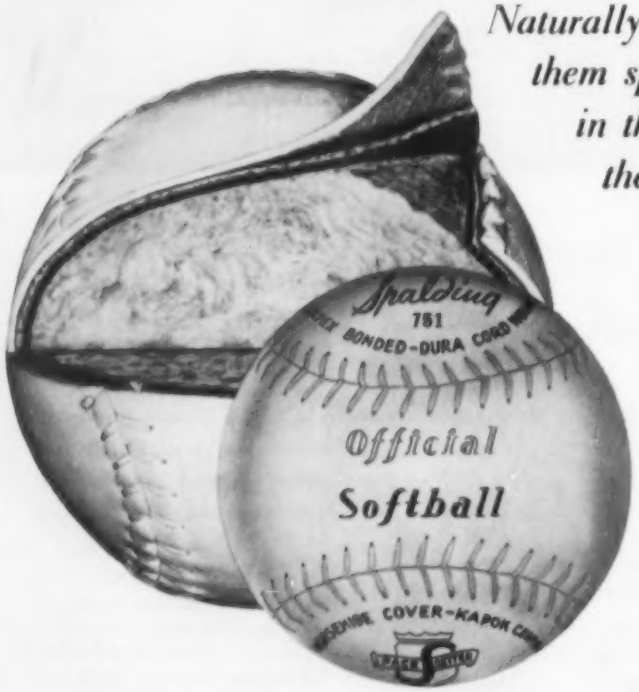
Angier Adhesives score high with SPALDING

For 80 years, sports minded millions have agreed that "Spalding sets the pace in sports."

Naturally, we are proud to have them specify an Angier Product in the latex bonding of their Softball Cover.



A firm, tight cover is an absolute necessity in the final construction of Spalding's Best Quality Softball.

To guarantee this, Spalding lines top-grade horse hide with Angier Latex for perfect adherence to the outer layer of winding before the final hand-sewing process.

Consult an Angier Products man early with your bonding problem. He represents 25 years of custom service in adhesives, coatings and sealants for pace-setters in every industry.

Write Dept. A for Free Descriptive Brochure

ANGIER PRODUCTS INC.

For Every Industry

Latest developments in Adhesives for
Honeycomb Construction, Vinyl Film Bonding
Rubber, Latex and Resin Cements
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Laminants and Sealants
Tie Coats Resin Emulsions

Angier Products 120 POTTER STREET, CAMBRIDGE 42, MASS.
Midwestern Plant: Huntington, Indiana

FOR DEPENDABLE POWER AND CONTROL
Choose The Finest

Hanna
FLUID T750 POWER CYLINDERS

The new Hanna T750 Series cylinders are the last word in smooth, dependable performance. These rugged, compact cylinders are built for air operation to 250 p.s.i. and oil or water operation to 750 p.s.i. Many mounting styles and interchangeable heads make these cylinders exceptionally versatile. Available in 1½", 2", 2½" and 3" diameters.

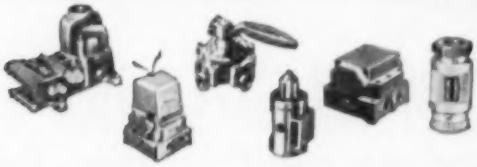
WRITE FOR CATALOG 750A

Hanna LP
AIR & HYDRAULIC CYLINDERS

For low pressure air and hydraulic operation. Thousands of varied applications have proved the quality and reliability of these Hanna cylinders. Bore sizes range from 4" to 14". These cylinders, combined with Hanna T750 Series cylinders, offer a complete range of cylinder sizes and mounting styles. Made in any practical stroke length.

WRITE FOR CATALOG 236B

Hanna
AIR AND HYDRAULIC VALVES



Designed to provide most efficient control for Hanna cylinders — ideal for other fine control jobs too. Many types available for hand, foot and electric operation, speed control, pilots and master for automatic and remote control.

Write for Catalog 254

Hanna Filters, Lubricators, Regulators, Traps

These accessories provide complete protection for precision-built cylinders and valves—will keep maintenance costs at a minimum.

Write for Catalog 105

Hanna HP
HYDRAULIC CYLINDERS

Hanna HP cylinders are without equal for strength, precision and power. For operating pressures up to 1500 p.s.i. Bore sizes range from 1½" to 8" in a complete selection of mounting styles. Heads are fastened directly to the cylinder tube, giving clean appearance.

WRITE FOR CATALOG 233B

Hanna Engineering Works

1771 Elston Avenue • Chicago 22, Illinois

HYDRAULIC AND PNEUMATIC EQUIPMENT . . . CYLINDERS . . . VALVES . . . RIVETERS

HERE IT IS! THE *New* THOMAS

Automatic Injection Molding Machine

SEE IT!
BOOTH
531
PLASTICS
EXPOSITION

PATENTS
APPLIED FOR

Revolutionary Electro-Hydraulic System Lowers Both Machine and Operating Costs

SPECIFICATIONS TYPE ND 30

¾ oz capacity
720 shots per hour—dry run
10 lb. per hour plasticizing capacity
9″ x 10″ mold space
6″ stroke
14″ daylight
15,000 psi injection pressure
30 tons maximum mold locking force
3 hp motor operates entire machine
Fully automatic operation
Motor and electrical controls by Westinghouse
2,200 lb. gross weight
28″ x 89″ floor space
Completely self-contained

The rugged new Thomas Automatic injection molding machine fills many vital needs. Its small size and low cost make it ideal for laboratory research work, college and trade training, market testing, mold testing and the economical production of small items. Because it is completely automatic, and features low pressure closing with safety drive, one operator can easily run a battery of these machines.

The basic difference between the new Thomas Automatic and others is the unique, new electro-hydraulic drive which uses power much more efficiently than conventional methods. It is completely self-contained, requires no auxiliary equipment and will mold nearly all thermoplastic materials including nylon.

WRITE *for brochure and complete information.*

THOMAS MACHINE DIVISION

NEWARK DIE COMPANY 22 Scott Street
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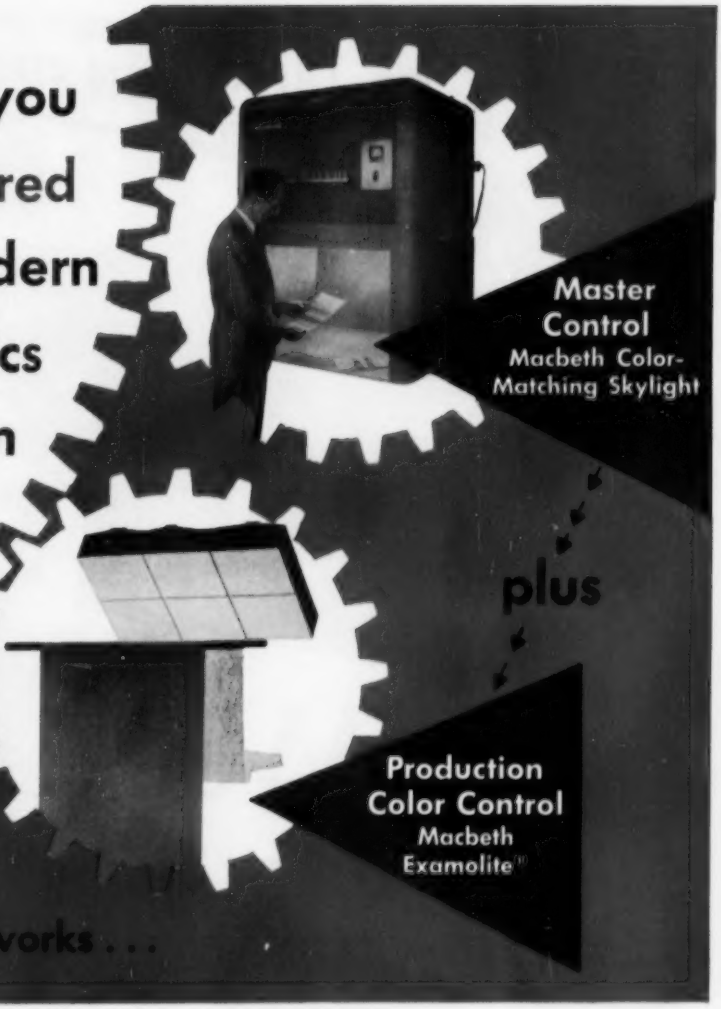
Today's high-style colors demand the most accurate color control. Only Macbeth offers coordinated color control for both laboratory and production use geared to modern color needs.

Are you Geared to modern Plastics Production Color Control?



Master Control
Macbeth Color-Matching Skylight

plus

Production Color Control
Macbeth Examolite®

Here's how this integrated Macbeth Color Control system works . . .

1. Laboratory Color Matching against customers' standard . . . ***Macbeth Color Matching Skylight***

2. Production matching against lab match and customers' sample . . . ***Macbeth Skylight*** (No. 1 above)

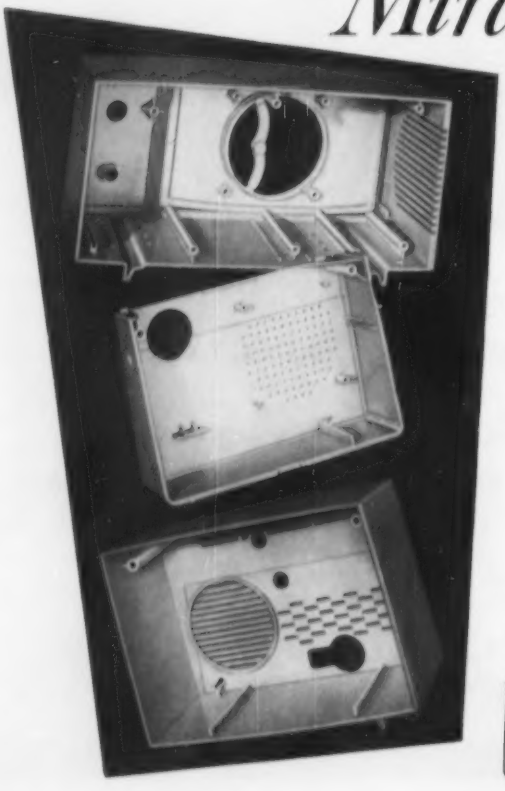
3. Production inspection for uniformity against production working standard . . . ***Macbeth Examolite®***

You are cordially invited to see Macbeth Color control equipment and discuss your color control problems at booth No. 701, the National Plastics Exposition at the New York Coliseum, June 11-15, 1956.

Macbeth Daylighting Corp.
a subsidiary of the Macbeth Corp., Newburgh, N.Y.

Westinghouse

"Miracle Mile" Quality



BRIDGEPORT HELPS WESTINGHOUSE PRODUCE ADVANCED RADIOS AT THE FAMOUS METUCHEN PLANT

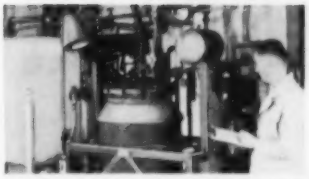
Incredibly complex machines . . . over 10 acres of electronic "day-after-tomorrow" manufacturing equipment . . . a production line over a mile long . . . combine to produce PRECISION-EERED television and radios like the models shown above! The last word in quality!

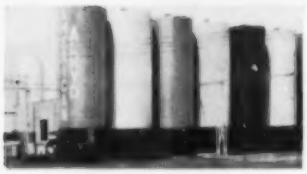
Bridgeport does their part — on advanced machinery and with modern production methods— to mold some of the intricate, durable plastic cabinets that play a role in Westinghouse performance. Not a step has been spared to make Westinghouse quality supreme in the industry.

Perhaps Bridgeport can help you produce superior products, too.

BRIDGEPORT MOULDED PRODUCTS, INC.

Box 3276 Barnum Station • Bridgeport 5, Conn.





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to the polyester resin specialists!

Take your polyester resin needs straight to the one source that makes them *exclusively*. As America's largest producer of government specified synthetic resins, our entire plant is devoted to research and production of these materials. Our capacity is as flexible as your needs. We can handle 1,000 pounds or 30 million pounds with the same ease, the same individual care, the same follow-thru. Concentrating on one job makes possible a custom kind of service that has paid off in an impressive list of American Alkyd customers. They appreciate the extra *service*, the extra *assistance*, the extra *quality* and the shortage of red tape! Send for *free* "Fact File" on polyester resins.

Manufacturers of Synthetic Resins . . . Reactive, General Purpose, Light Stabilized, Thexotropic, Flexible, Fire Retardant, Gel Coat.

For complete information, call the President

AMERICAN ALKYD INDUSTRIES

Broad and 14th Streets, Carlstadt, N. J. • Geneva 8-4332

Why 371 U. S. manufacturers now enjoy 100% tax

Governor Muñoz tells why Puerto Rico offers such amazing incentives to new or expanding manufacturers.

"IN THIS statement, I shall try to explain Puerto Rico's economic position as frankly as I would to any manufacturer or labor leader who met me face to face.

Puerto Rico is currently making a determined effort to stand squarely on its own economic feet. At present we do not have nearly enough jobs to support our people. We are therefore directing every energy to create more jobs at home, and to curtail migration to the States.

That is precisely why we are going all out to attract every *new* plant we possibly can. But, to date, we are still providing only 25% of the new jobs we need *each year* to keep pace with our expanding labor force. I shall go into details later. But first I want to make two points of my Government's policy absolutely clear:

> **1. Puerto Rico has no intention of winning industries *away* from anywhere. We do not grant tax concessions to *runaway* plants.**
>
> **2. Puerto Rico's Industrial Development Plan is based on a combination of absolutely ethical incentives. We do *not* and *never will* hold out low wages as an attraction to business. My Government's firm philosophy is that wages should rise as rapidly as our economic development permits.**

Let me now describe our basic problem in more detail."

Our Problem

"When people talk of over-population as Puerto Rico's biggest headache, they certainly don't exaggerate.

Our unemployment is high. Our income level is still low—only 25% of the U. S. average. And every year 20,000 more workers swell our under-employed labor forces.

But this is probably putting the cart before the horse. Our real problem is not over-population but *under*-development. What then is our best solution?"

Our Solution

"I am convinced that the answer can only lie in more and more industry. Hence we are pinning our major hopes on our industrial development program, as the main pull of what we call Operation Bootstrap.

From the economic standpoint, Operation Bootstrap has but one simple aim—to develop industry, and in doing so, to encourage U. S. manufacturers to *expand* their operations to Puerto Rico. Operation Bootstrap is, in fact, a bold attempt to increase the well-being of our whole Commonwealth—workers and employers alike. And lest anyone should fear that my country's program might injure the U. S. economy, let me now sound a reassuring note:

> **1. The U. S. already has 65 *million* employed. Puerto Rico only needs to create 150 *thousand* new jobs to solve its present problem.**
>
> **2. One half of one percent of normal U. S. industrial *expansion* would achieve our whole economic program.**

I hope these comparisons help to put Puerto Rico's modest needs in proper perspective. But, for good measure, let me quote a few more figures to show how important a prosperous Puerto Rico is to U. S. business itself:

> **In 1955, Puerto Rico's purchases from the U. S. rose to $580,000,000. *Without* Puerto Rico as a customer, New York's gross sales would have dropped by $67,000,000; California's by $54,000,000; New England's by $53,000,000.**

So much for statistics. Now just a word about my people, without whose willing co-operation Operation Bootstrap would merely be a sterile dream."

Bootstrap Underway

"Pay us a visit and I think you will be impressed immediately by the wholehearted faith we Puerto Ricans place in Operation Bootstrap.

We believe in it deeply and thoroughly—and, with practically no exceptions, support its policies right along the line. Thus, I can promise the same eager, cheerful co-operation to every U. S. manufacturer who expands his industry to our Commonwealth.

Scarcely a month goes by that I am not visited by the Mayors of a dozen Puerto Rican towns, all asking for plants to be erected in *their* areas. There's not a community in all Puerto Rico that would not enthusiastically welcome the arrival of a new factory.

For we all realize that though we have made a promising start up the long, long hill to economic prosperity—the summit is not in sight yet. But the Puerto Rican people have squared up to their challenge and are meeting it in good heart."

in Puerto Rico freedom

Corporate Tax Exemption

If your net profit after U. S. Corporate Income Tax is :	Your net profit in Puerto Rico would be :
$ 29,500	$ 50,000
53,500	100,000
245,500	500,000
485,500	1,000,000

Dividend Tax Exemption*

If your income after U. S. Individual Income Tax is :	Your net income in Puerto Rico would be :
$ 7,760	$ 10,000
15,850	25,000
25,180	50,000
51,180	200,000

*Dividends are tax-free only if paid to residents of Puerto Rico by a tax-exempt corporation. Examples are based on Federal rates (Jan. 1, 1956) for single persons.

Beardsley Ruml tells how new or expanding industries (not runaway plants) get tax exemption.

"START A NEW plant in Puerto Rico and you are not only free from Federal income taxes (they don't apply) – you can be exempt from *local* income taxes too. Your freedom from Federal taxes is *not* a concession. It is a *Constitutional* fact which stems logically from that historic American principle 'Taxation without representation is tyranny.' Puerto Rico has no vote in Congress, and therefore no Federal income taxes – corporate or personal."

Protected by Two Constitutions

"Your business is not only protected by the Commonwealth Constitution, it is permanently guarded by all the guarantees of the U. S. Courts and Constitution, too.

As for your *local* income tax exemption, this is an *added* incentive, offered by the Commonwealth Government to attract new plants that Puerto Rico's economy needs so urgently."

How you gain from a new plant in Puerto Rico

1. A better return. Local tax concessions, freedom from Federal taxes, and lower operating costs will all reflect favorably in your company's balance sheet. See table above.

2. Abundant, skillful labor. Puerto Rico's labor force totals 644,000. The Commonwealth operates an ambitious vocational training program, which will even screen workers and teach them *specially* to operate your machines. The adeptness of the Puerto Rican worker in learning precision skills may be judged by the fact that the following famous companies now have operations in Puerto Rico:

Remington Rand. St. Regis Paper. Beaunit Mills. International Latex. Carborundum Company. Shoe Corporation of America. United Tool and Drill. Sunbeam Electric. Univis Lens. Weston Electrical Instrument Company.

3. No currency or customs problems. Puerto Rico is a Commonwealth freely associated with the United States. It is an integral part of the U. S. economic system. You have none of the problems of operating from a foreign country. Movement of goods, money and people between Puerto Rico and the U. S. is as free as it is between the states of the Union. There's no duty on trade and the U. S. dollar is currency.

4. Low capital investment. New single-story, low-rental factories are ready to occupy. The government will even build a *special* one for you on a very small down payment. Abundant electricity, gas and water are just waiting to be connected.

5. Ideal location. Puerto Rico is served by 30 ocean lines and 8 airlines. It is only 5½ hours by air from New York – less than 4 from Miami. Goods are actually made in Puerto Rico one day and are delivered in Los Angeles the next. The climate is perpetual Spring. Temperature stays around the balmy 70's most of the year. Swimming, sailing and fishing are superb. Domestic help is plentiful.

Is Your Company Eligible?

To find out if your company is eligible for tax exemption in Puerto Rico, call our nearest office:

New York MU 8-2960 579 5th Ave.
Chicago AN 3-4887 79 W. Monroe
Los Angeles WE 1-1225 5525 Wilshire

Or mail coupon for free booklet

Commonwealth of Puerto Rico
Economic Development Administration
579 Fifth Ave., New York 17, N. Y.
Dept. MP-61

Mail me "Facts for the Manufacturer," your report of the advantages of Puerto Rico for plant location.

Name _____

Company _____

Product _____

Address _____

_____

Announcing

THE NEW FORMABLE

SEILON. POLYETHYLENE

Heavy molded shapes can now be vacuum formed, saving on tool costs and equipment costs in industrial applications and consumer items!

Available gauges: .020 through .125

Width 48″—length in continuous rolls or cut to minimum 48″ sheet length.

Standard color: Natural

OTHER TYPES OF FORMABLE SEILON MATERIALS ARE:

Vinyl Copolymer LC (normal impact)
FHI (high impact)

S-3 (tough thermoplastic polymer having excellent balance of properties)

DELIVERY IS PROMPT

Seiberling Plastics Division is adaptable to customers' requests. We will welcome the opportunity to consult with you on individual specifications of properties, gauges, colors and finishes for your products.

Plastics Division **SEIBERLING RUBBER COMPANY**

NEWCOMERSTOWN, OHIO • PHONE 8-8304

Typical statements from satisfied users of...

Thermex
PLASTIC PREHEATING APPARATUS

"Improves Quality!"

At Insulation Manufacturing Co.

"We produce better products faster with Thermex Plastic Preheating Apparatus", reports Insulation Manufacturing Co., Inc., Brooklyn, N. Y. Uniform heating and curing is the basic reason for the top quality and widespread acceptance of this company's products. They bought their first Thermex• unit in 1943—now have eight giving perfect, high-speed production!

"Increases Production!"

At American Insulator Corp.

Faster production, More Uniform Molding Results, Lower Costs—that's what Thermex equipment has meant to American Insulator Corp. A total of 24 Thermex Plastic Preheating Units of 5-KW and 3-KW capacity have been installed by this firm during the past 8 years—have given highly dependable service during continuous plant schedule of 100 hours per week, 50 weeks per year!

"Cuts Costs!"

At Kenro Corp.

"Thermex units give us more for our money", states K. B. Welch, President, Kenro Corporation. "After trying several makes of preheaters, we found the Girdler unit superior", he continues. "We preferred it because it is designed better . . . more compact, easier to operate and its heating is even and dependable". On the basis of the tests, Kenro has purchased two Thermex units.

"Cuts Rejects!"

At Sperzel Co.

"Studies show rejects cut 33%, production up 33%, maintenance costs cut 50% with our five Thermex Plastic Preheating Units", says Sperzel Co., Minneapolis. "In over 15 years of molding we have used several types of preheaters . . . but there's no doubt that Thermex is outstanding. Thermex units have meant a smoother and more profitable molding operation for us!"

● Find out how *you* can speed up production, improve quality and cut costs with Thermex Plastic Preheating Apparatus. If you wish, a Thermex field engineer will study your operation and make recommendations. Call or write The Girdler Company, Thermex Division, Louisville 1, Kentucky.

•THERMEX—Trade-Mark Reg. U. S. Pat. Off.

The GIRDLER Company

A Division of National Cylinder Gas Company

THERMEX DIVISION • LOUISVILLE 1, KENTUCKY

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239 Newton Avenue, Newark, Ohio • 624 South Michigan Avenue, Chicago 23, Illinois • 714 West Olympic Boulevard, Los Angeles, California.

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Puts you in the driver's seat!

No longer need you be satisfied with half-measures. Now you can say "I want what I want when I want it." And FLIGHTEX will make sure you get it.

Our research laboratories and development facilities are always ready to help find the exact fabrics to meet your specifications. Our plants are ready to produce these fabrics with consistent, uniformly high quality.

Service . . . plus quality . . . plus dependability . . . no wonder more and more glass cloth users call FLIGHTEX their favorite source of supply.

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World's Premier Industrial Fabrics

FLIGHTEX FABRIC

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W. S. SAMPSON, JR., Boston, Mass.
KURT W. SCHMIDT & ASSOCIATES, Dayton, Ohio
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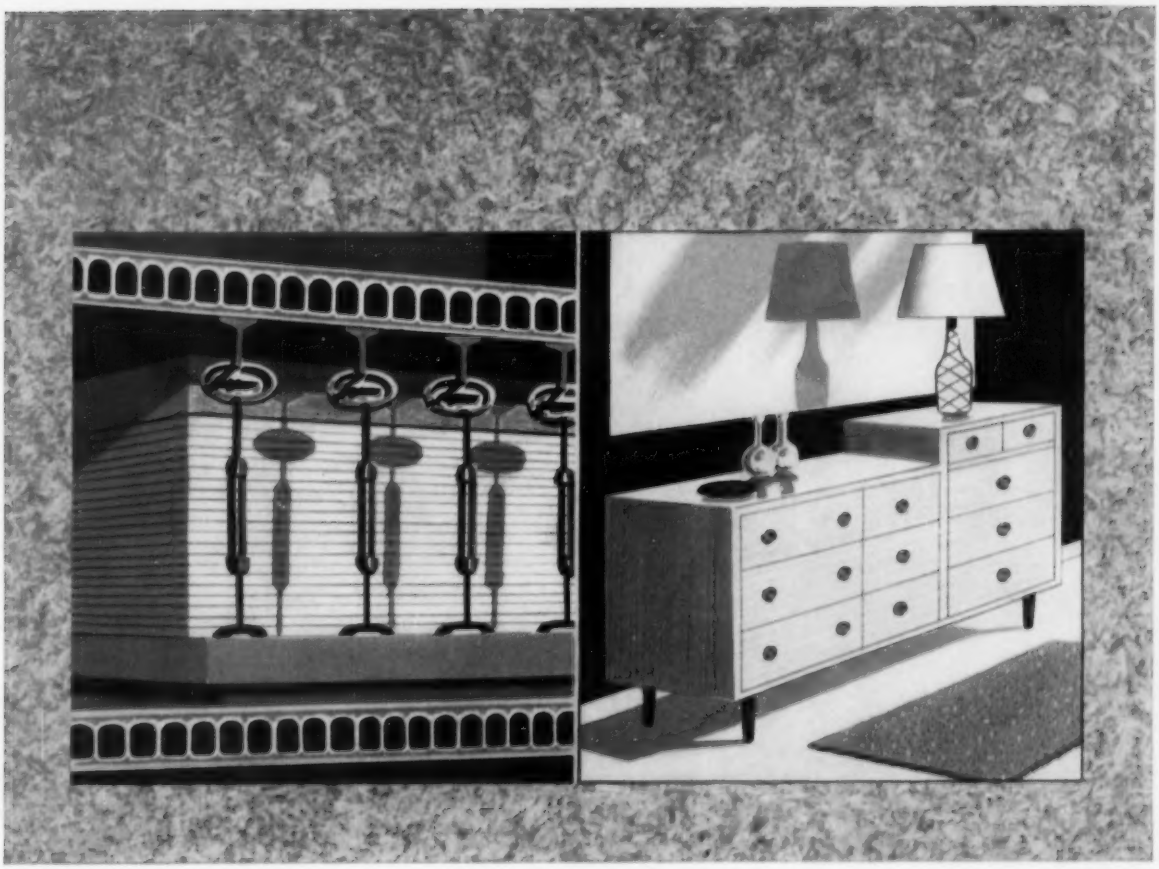

WEYERHAEUSER 4-SQUARE PARTICLE BOARD—

Your Answer to Low-Cost Fabrication

READY TO USE without sanding, kiln-drying, planing! No knots, no grain to twist or warp! Dimensionally stable, highly resistant to splitting! Can be end glued for extra length, also trim can be edge glued into larger panels to minimize waste.

These are just a few of the money-saving advantages of Weyerhaeuser 4-Square Particle Board, the new and different core material for decorative laminated plastics and wood veneers.

Think of the many places this new core material can mean profit to you . . . in trouble-free, warp-resistant sliding doors; in strong, durable, beautifully finished dresser, table and counter tops; in quickly produced, easily assembled fixtures and parts.

Weyerhaeuser 4-Square Particle Board also is an ideal base for dinette table tops, sink tops, bar tops; for case and cabinet goods; furniture and displays; any product requiring a quality core. Also can be veneered or surfaced for beautiful interior panelling. Comes in 4′ by 8′ panels or cut to your size requirements in thicknesses of $\frac{3}{8}$″, $\frac{1}{2}$″, $\frac{5}{8}$″, $\frac{3}{4}$″ and 1″. Densities for 3 and 5 ply use.

WRITE FOR SAMPLE

See it. Test it. You'll quickly realize the possibility of important savings and better products for you.

Weyerhaeuser Sales Company

DEPARTMENT PJ-66

First National Bank Building • St. Paul 1, Minnesota

Trims and Pierces Vacuum-Formed Plastics

Dake Hydraulic Presses are designed to manufacturer's specifications with large area, low tonnage, and plenty of "daylight."

Dake Plastic Trimming Press with a refrigerator inner door liner in position for piercing and trimming. Workman is about to lower the platen.

When Kent Plastics Corporation, Evansville, Ind., decided to manufacture vacuum-formed plastics, they wanted efficient equipment both for forming and for trimming and piercing products made from high-impact polystyrene sheet.

Since Dake Plastics Molding Presses are widely known and used in the industry, Kent engineers turned to Dake for assistance. Dake engineers were glad to co-operate in developing a trimming and piercing press with over-all size, bed area, tonnage, stroke, and speeds (both advance and pressing) suited to Kent's requirements. The first press proved so satisfactory in operation that a second one (with slightly different specifications) has now been built and installed.

Dake will gladly work with you to provide a trimming and piercing press exactly suited to your needs. For descriptive literature on these presses, write for Bulletin 352.

Workman at Kent Plastics Corp. prepares the second Dake Press to receive a die. Original press is in operation at left.

DAKE CORPORATION, 648 Seventh St., Grand Haven, Mich.

DAKE PRESSES

COLORS...
CHEMICALS...
FIBERGLASS
REINFORCEMENTS
for PLASTICS

FERRO

FERRO CORPORATION

A COMPANY GROWN BIG THROUGH SERVICE

SPI 7th national Plastics exposition new york coliseum june 11-15, 1956 booths 1120-1122-1124

light stable colors
. . . for all plastic materials
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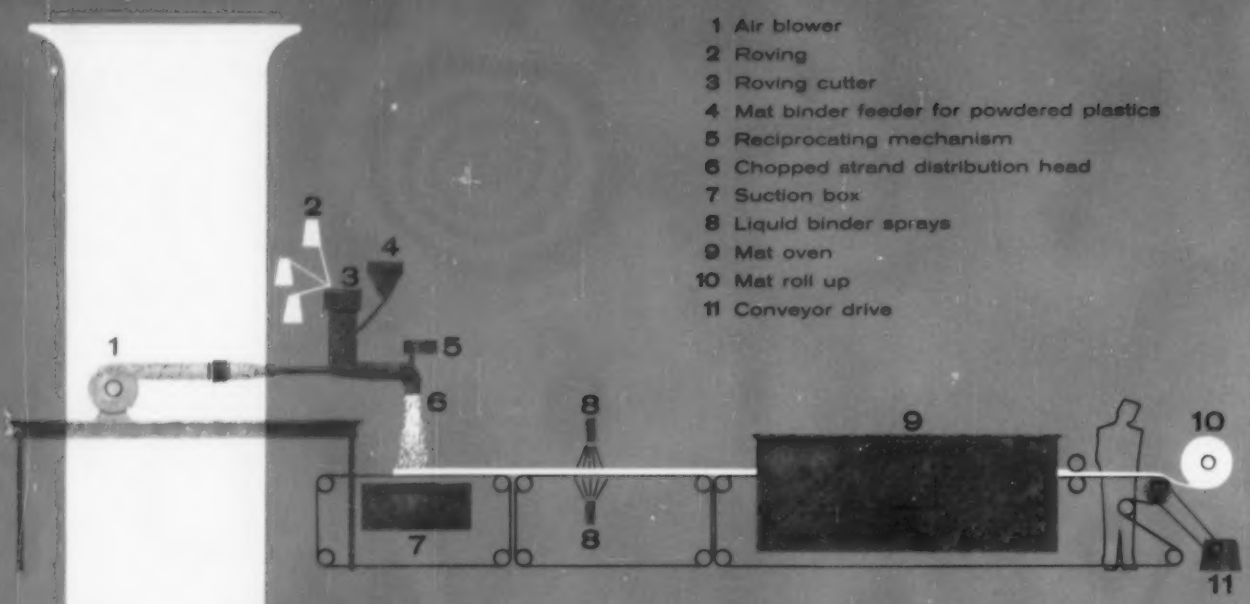

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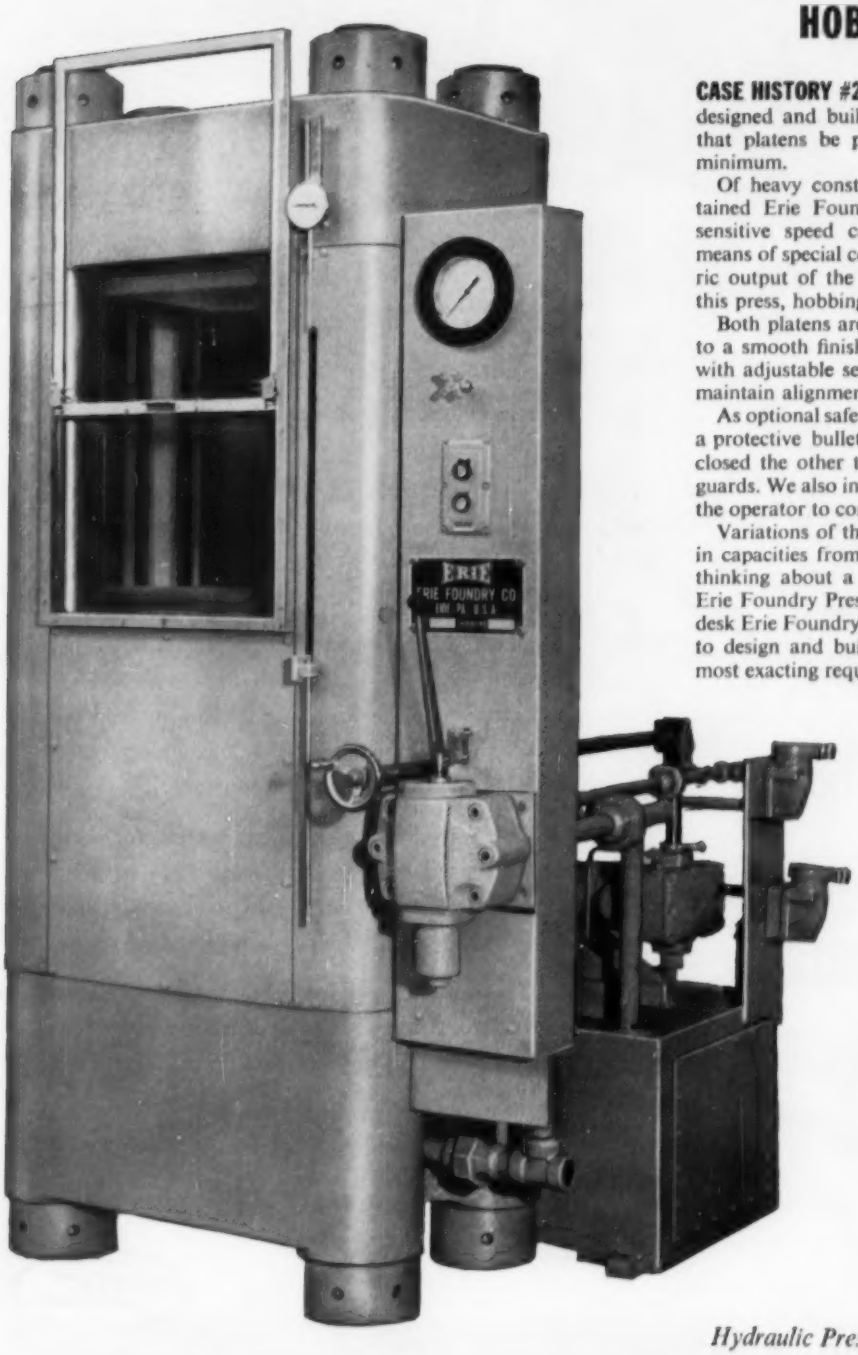

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CASE HISTORY #2—This 500 ton Hobbing Press was designed and built for a customer who demanded that platens be parallel and deflection kept to a minimum.

Of heavy construction throughout, the self-contained Erie Foundry Hobbing Press achieves the sensitive speed control essential for hobbing by means of special controls which change the volumetric output of the pump under load (pressure). On this press, hobbing is a smooth, sensitive operation.

Both platens are accurately machined and ground to a smooth finish and the ram platen is equipped with adjustable semi-steel guides on each corner to maintain alignment.

As optional safety equipment, Erie Foundry added a protective bullet-proof glass sliding door and enclosed the other three sides of the press with steel guards. We also installed a depth gauge which allows the operator to control each hob accurately.

Variations of this hobbing press can be furnished in capacities from 200 ton to 3000 ton. If you are thinking about a new hydraulic press, call in the Erie Foundry Press Engineer. He will bring to your desk Erie Foundry Company's experience and ability to design and build a press which will meet your most exacting requirements.

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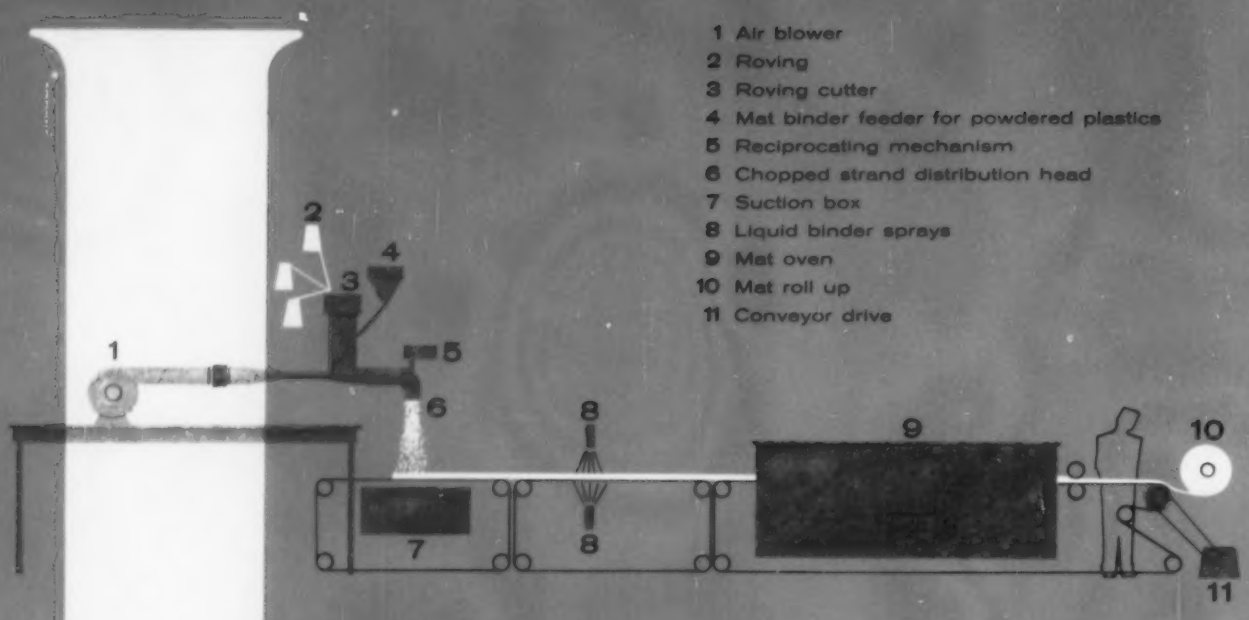

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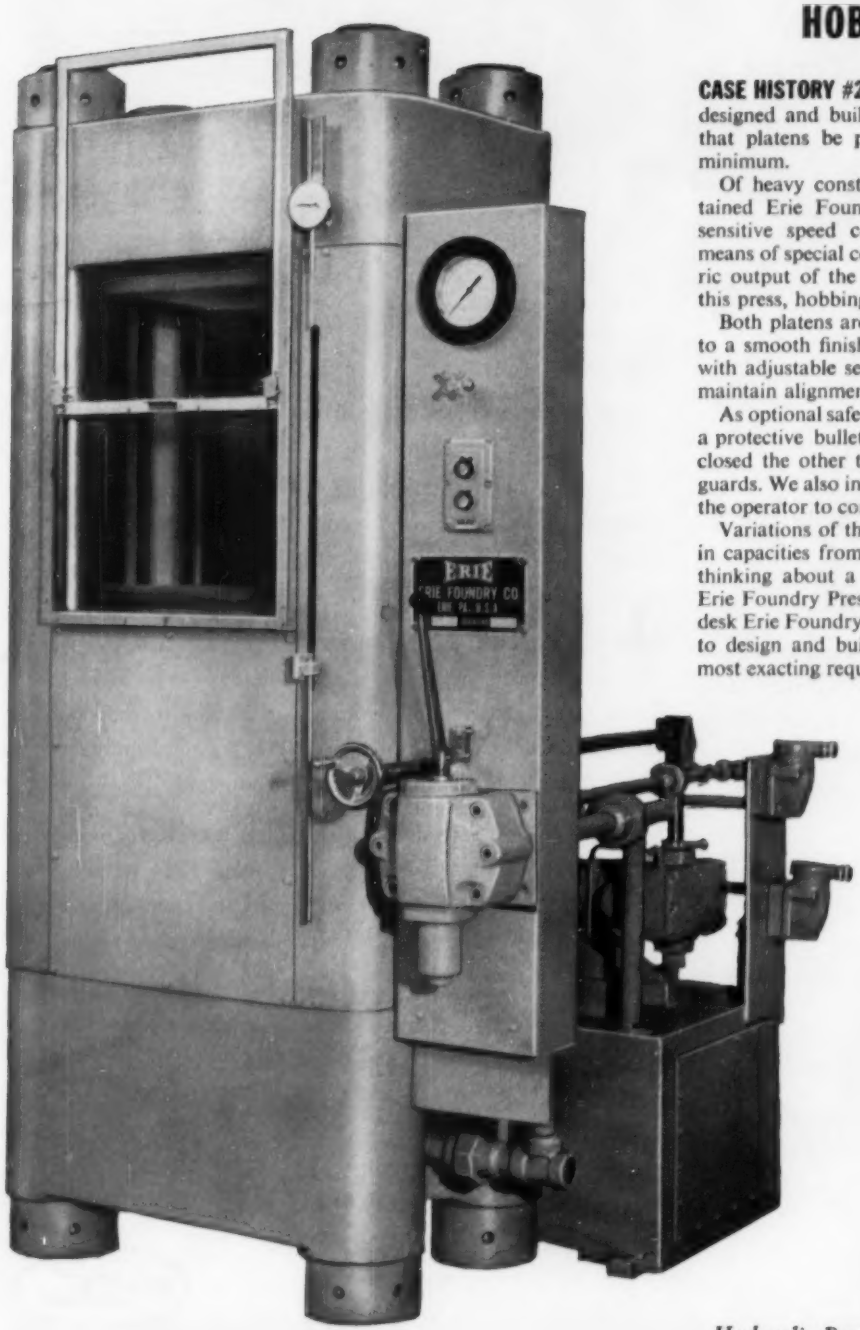
ERIE PRESS OF THE MONTH



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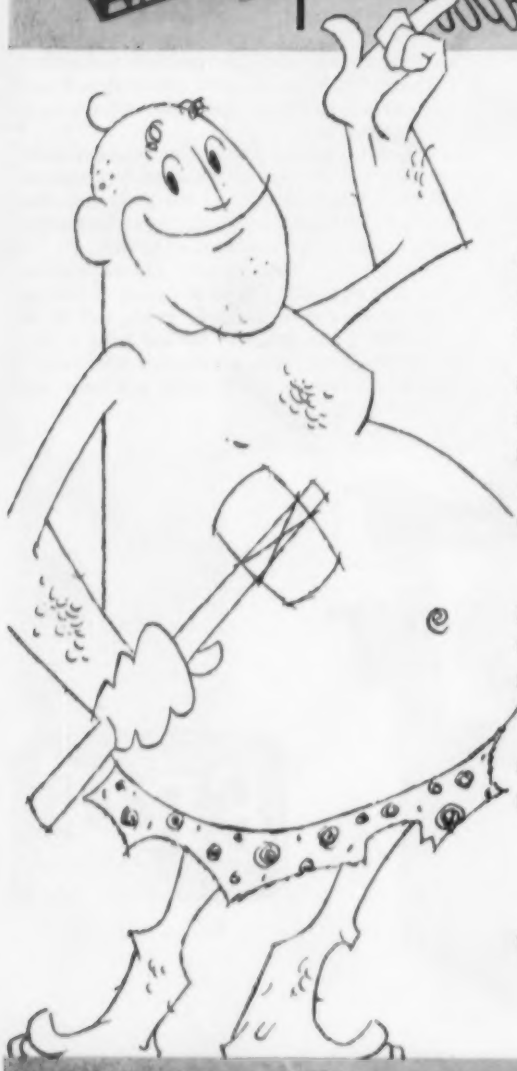

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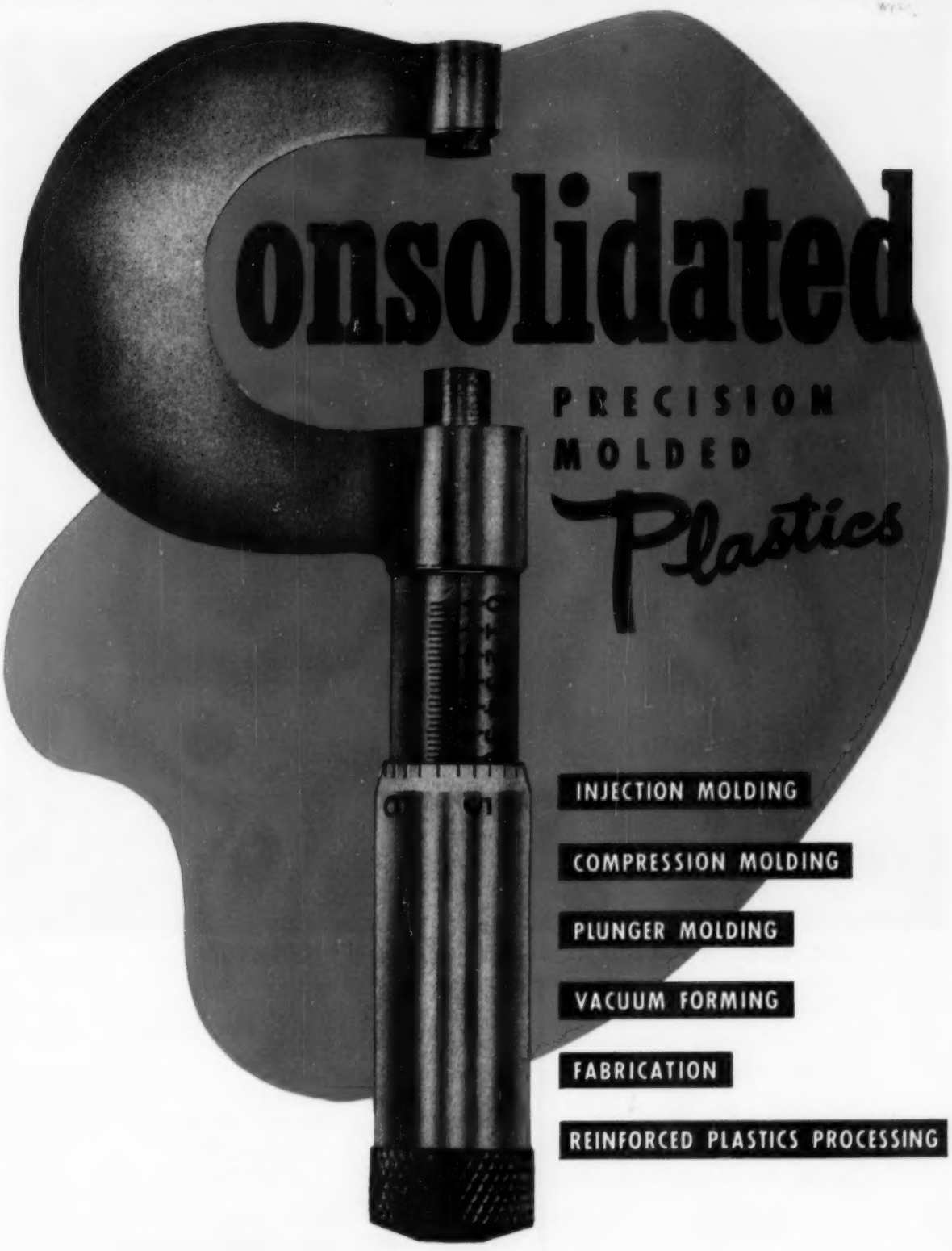

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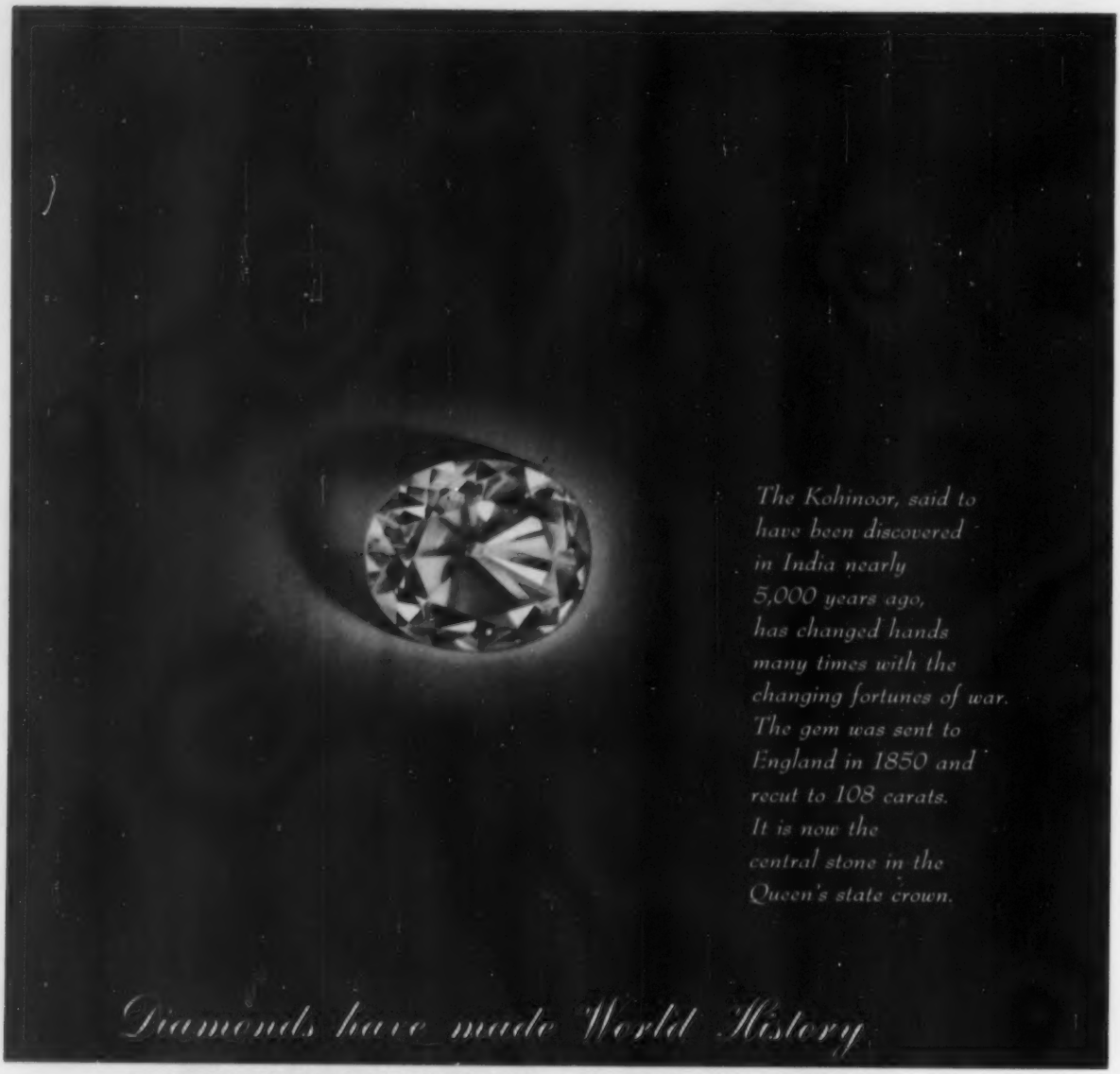
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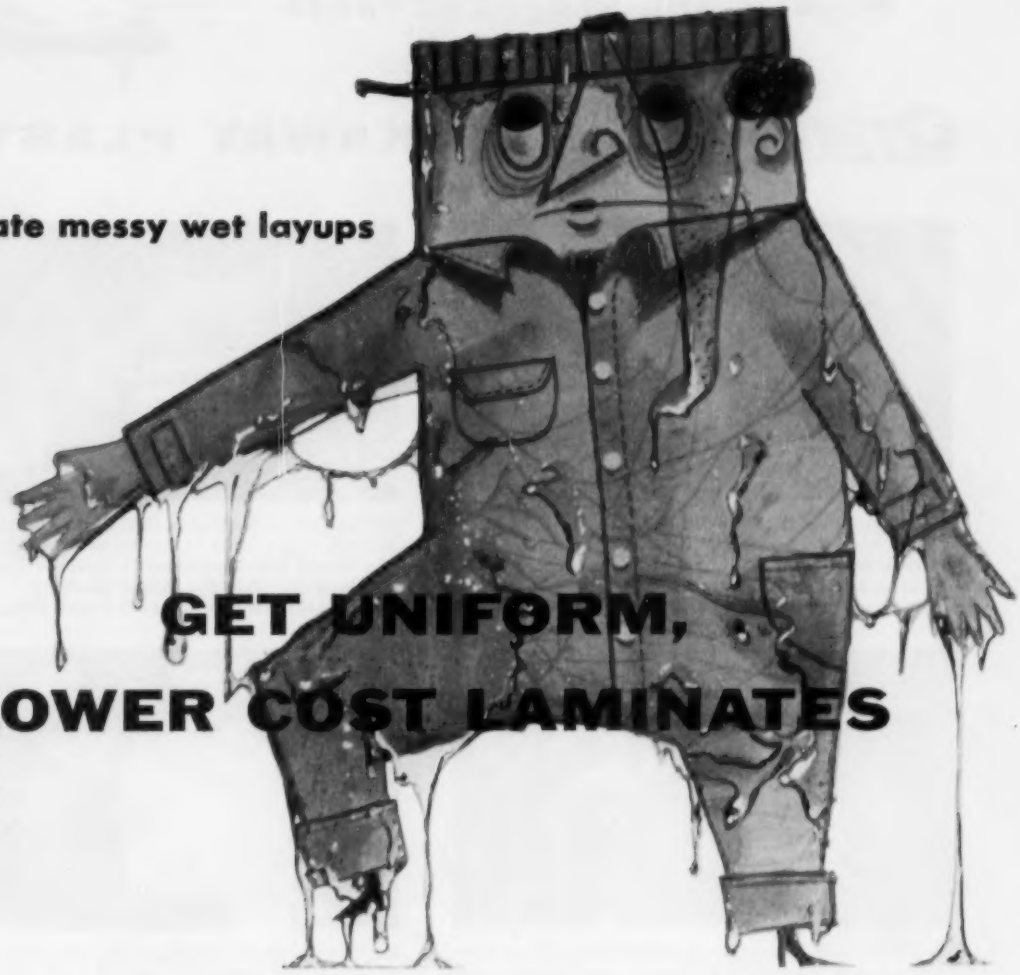

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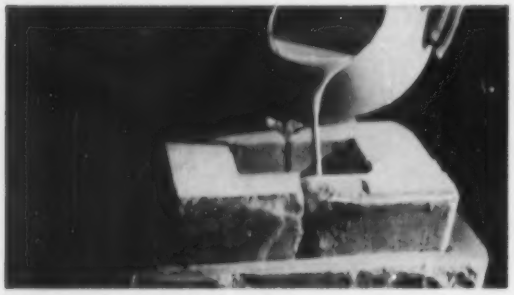
HOW VERTOL AIRCRAFT FORMS HOLLOW PLASTIC AND NEOPRENE PARTS WITH NEW

Certain-teed® BREAKAWAY PLASTER



Here Certain-teed Breakaway Plaster is being poured into a plaster mold at the Vertol Aircraft Corporation plant at Morton, near Philadelphia. This is the first step in making an expendable Breakaway mandrel on which a polyester laminate compass support will be formed.

Another use for Breakaway Plaster at Vertol. A Breakaway mandrel, used to make a neoprene power plant control boot in a Vertol H-21C Helicopter, is removed from a rubber forming mold. Molds for casting mandrels of Certain-teed Breakaway Plaster may be of metal, wood, rubber or plaster.

Workman applies parting agent to Breakaway Plaster mandrel to prevent adhesion of the plaster to the Neoprene part. Lighter pieces in background are the plastic laminates applied over the mandrels. Darker pieces at the right have been coated with Neoprene and are ready for curing.

Here the Certain-teed Breakaway Plaster is being washed out of the molded power plant control boot after the curing operation. Water at 170° F. quickly flushes the expendable Breakaway mandrel from the most intricate shapes without malforming or breaking the part.

Certain-teed's new, improved Breakaway Plaster is a gypsum base composition specially formulated for the production of hollow shapes formed of glass fiber mats reinforced with resins. With this new formula, excellent results can be obtained more quickly and easily, and at less cost than ever before.

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Breakaway Plaster can be quickly and easily *washed* out of the most intricate shapes with hot water or steam. It is readily adaptable to any contour.

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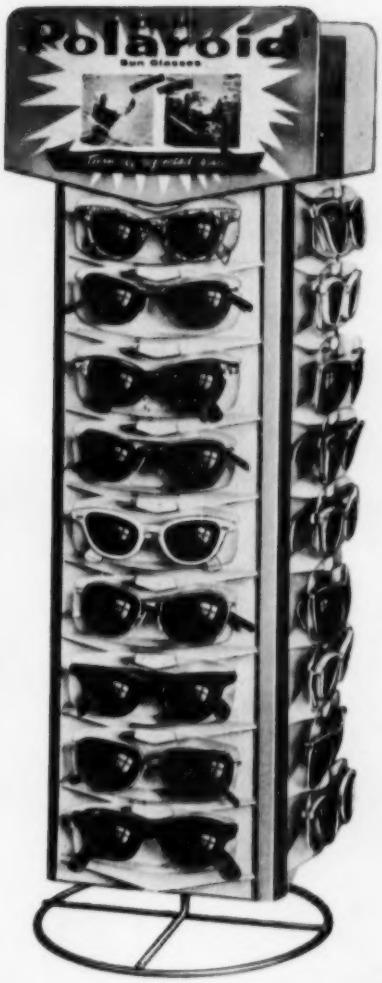

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25-inch rotary display designed and vacuum formed by Mechtronics Corp., Mamaroneck, N. Y.

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See this display among others at NIXON'S booths, 315, 317, the 7th Annual Plastics Exhibition, N. Y. Coliseum, June 11 to 15.

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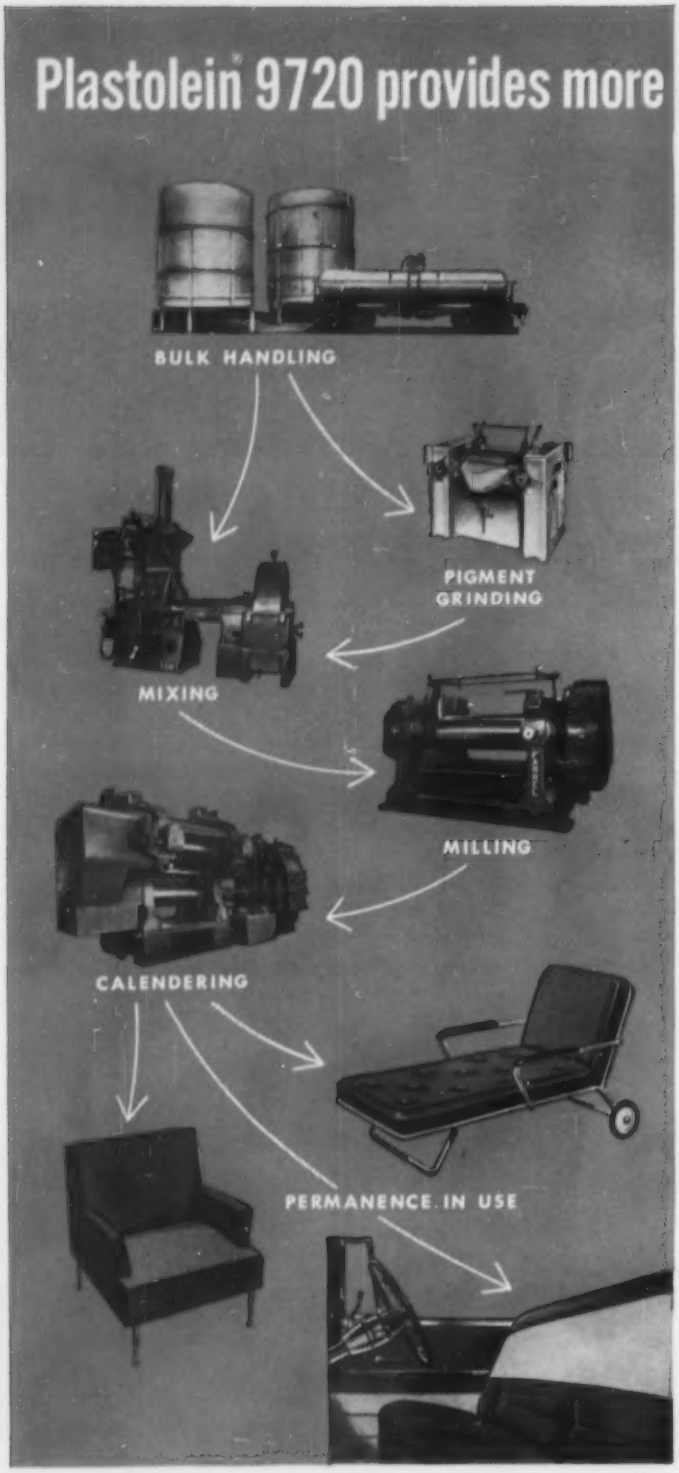
Neat, efficient installations of BIPEL Presses (above) and Preformers (below) at M.K. Electric, Ltd., courtesy BRITISH PLASTICS.

Plastolein 9720 provides more measurable advantages



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MODERN PLASTICS
Volume 33
June 1956
Number 10

Plastics in THE YEARS AHEAD

In 1955 the plastics industries confounded the prophets and even surprised themselves by achieving a sales volume of 3½ billion pounds, representing an increase of a billion pounds or around 30%—over 1954.

This took place in a year when the population reached 165 million persons and the gross national product about $387 billion. The plastics industries not only expanded almost all their markets, but opened up new and broader bases of application, becoming more thoroughly integrated with the whole economy.

The public at large, the industries which use plastics, the industries which compete with plastics, and the plastics industries themselves, having witnessed progress proportionately far exceeding that of most other industries, now ask: "Where do plastics go from here?"

On this, the occasion of the 7th National Plastics Exposition, the editors of MODERN PLASTICS have analyzed the place of plastics and the pace and direction of plastics development in the years ahead. Herewith the picture, as they see it, is presented.

The main feature of the issue, dealing with this vital subject, is presented in four sections: Market Factors Affecting Plastics in the Years Ahead p. 150, Plastics Materials in the Years Ahead p. 155, Plastics Applications in the Years Ahead p. 164, Plastics Engineering in the Years Ahead p. 179.

The first section offers a conservative consensus of leading economists on the growth pattern of the total U. S. economy. The projections are based on population trends, family formation and birth rates, gross national product, and foreseeable increase in disposable and discretionary income.

The second section is concerned with the prospects for plastics expansion up to 1960, based on material makers' plans and objectives and on use trends which are in evidence for plastics materials.

The third section shows the relationship between present design and application developments to future increased use of plastics in every important field of use. Projections to specific years ahead vary according to the best predictions obtainable from experts in those fields. The editors' main object in this section has been to expose the pattern of application development.

The fourth section relates to trends in engineering and equipment design to serve plastics processing needs in the years ahead.

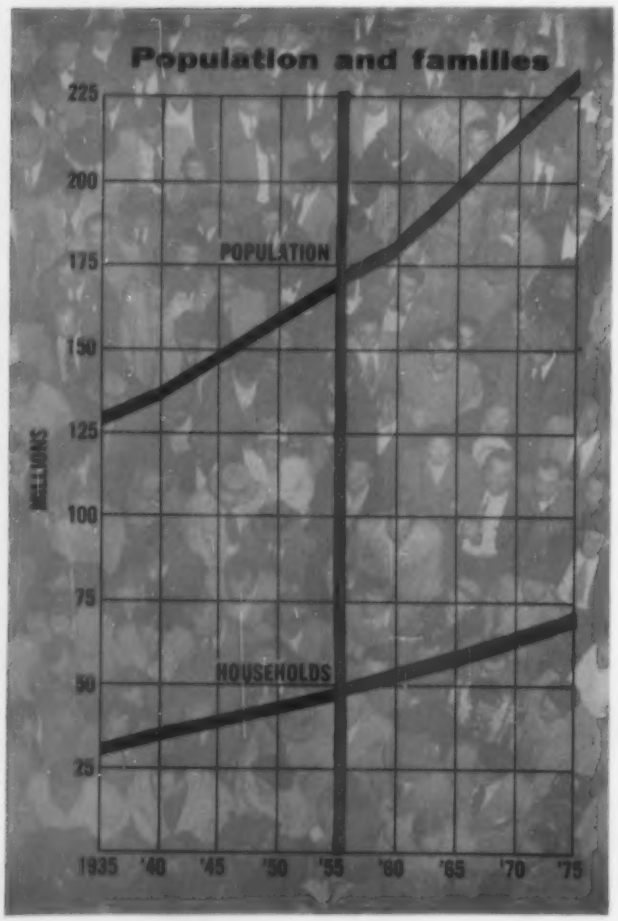
While this whole feature has been staff prepared, the editors' thanks are due to over 300 men in the plastics industry, in end user industries, in industrial design organizations, in government, in universities, in trade and industrial associations for their contributions in opinion and criticism to the end that this feature might be both useful and inspirational, not only now—but in the years ahead.

Market factors affecting plastics in THE YEARS AHEAD

Because plastics as components of end products depend to such an extent on the market health of the American economy as a whole, a study of the most important pressures for expansion is cogent to any attempt at prediction.

The growth of certain elements in the economy is readily predictable. The growth of population and number of families has been charted up to 1975 (see Chart 1) as has also the breakdown of population in any year between now and then according to age groups. (See Table I.)

CHART 1



We also know the gross national product potential for any given future year. This is an important factor, because out of that sum will come taxes, investment, and the income of the people. If the gross national product is high enough per capita, the disposable income will be high, as will also discretionary spending power, which is the key to our rising standard of living. Out of gross national product comes business capital expenditures, construction of homes, schools, and highways—all keys to future markets for plastics.

The total population in the United States, barring war or pestilence, should grow from a present 165 million people to 190 million people in 1965, to 227.5 million people in 1975. The number of households in the country should grow from a present 48 million to 56 million in 1965, to more than 66 million in 1975. In the salutary economic climate of recent years, the size of the average family has increased from 3.2 persons to 3.4 persons per household, is expected to remain at that level or a little higher through 1956; under continuing good economic conditions, family size may climb to even higher levels in the following decade.

Significance of age groups

The number of people which will be available in any given year to produce goods and services is the first factor in establishing the rate and type of industrial expansion. This labor force factor, coupled with hours worked, can affect the gross national product and every component of that product. The number of people 65 years and older and those under 18 years

of age, in any period, establishes our need for social services, schools, home enlargement and modernization, and has a tremendous effect on all markets for plastics. Table I is almost explosive in its import. In 1965 we will have at least 5 million more children under the age of nine than at present, at least 3½ million more between 10 and 13 years of age, 4 million more between the ages of 14 and 17. And we will have 3½ million more people 65 years of age and over. In the age groups from 18 to 64—in the working years—our population will have only about 7 million more men and women than today.

Changing living standards

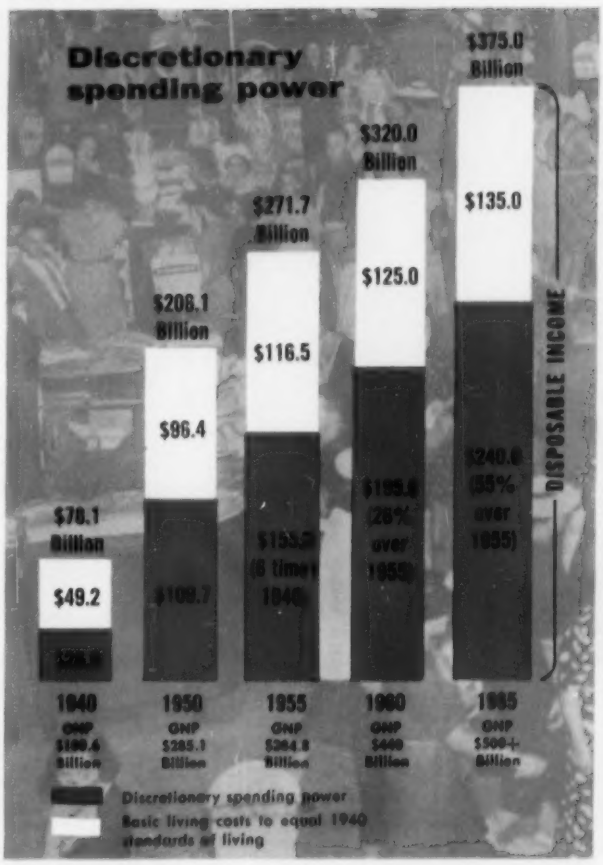
How people are going to live and where they are going to live are things also predictable for at least a decade ahead, and they concern markets for plastics in a number of ways. During the past five years, when prices have been relatively stable, millions of families have climbed upward in income groups and therefore in discretionary spending power. In four years between 1950 and 1954, the number of families with incomes of $4000 after taxes increased from 12.2 million to 21.4 million; in 1956 this group will reach 25.8 million and by 1965 will be well over 35 million. Chart 2 shows the over-all rise in discretionary spending power over a 25-year period.

Suburbia is growing six times as fast as the population of urban areas. In the past five years, while the total population increased 7.9%, big city population increased only 3.8%, small city population increased 5%, rural population dropped 1.9%—and the population in the suburbs of our major cities increased 27.8 percent! This trend continues unabated. It is a reflection of a) family growth, b) higher disposable incomes, and c) shorter work weeks and accompanying increased leisure. It is the chief key to the market for new homes, for appliances and fittings for those homes, for schools, for automobiles, and for other products and services; and it is one of the major stimuli behind the growth of the shopping center, the emphasis on self-service selling, the new methods of packaging, and other noticeable changes in our economy.

More educated adults

A third factor in future markets is the changing education level. In 1940 only 27% of the population 20 years of age and over were high school graduates; in 1955, 42%—a 90% increase. By 1965 at least 60% of the population over 20 years of age will have graduated from high school. People with better educations have higher standards of living and, generally, greater earning power. This, in turn, is transmitted to the next generation, thus keeping living standards rising.

CHART 2

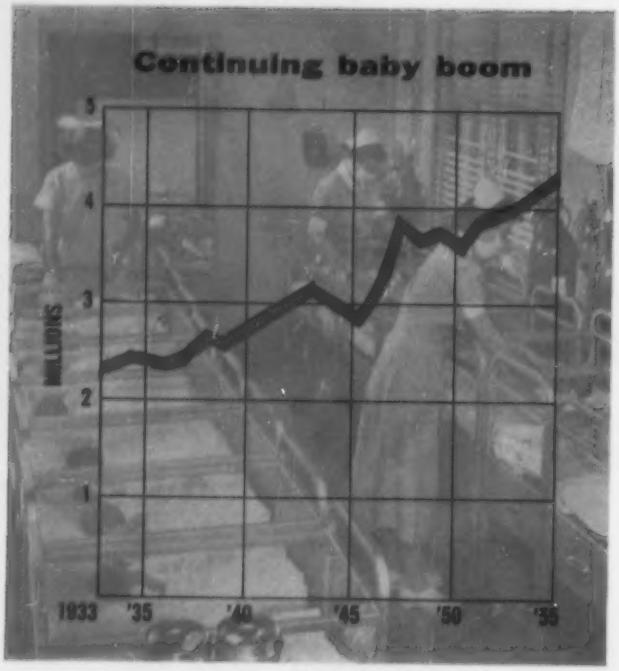


Courtesy J. Walter Thompson Co.

Baby boom continues

The fourth factor in any picture of the future lies in the birth rate. The low point in two decades in the number of people reaching the age of 21 was 1954, because of the low birth rate of the depression years. Beginning in 1960, when babies born during World War II start reaching maturity, these ranks will swell, giving us faster family formation and an increasing labor force. Meanwhile, births increased from a low of 2.3 million in 1933 to 4.2 million in 1955 (Chart 3), and the birth rate is still increasing, with more families having second,

CHART 3



third, and fourth children. The effect this increasing birthrate will have on the American marketing economy in the era beginning with 1975 is obvious.

Credit can still expand

Factor number five in the future picture is the matter of credit and finance, at both consumer and industry levels. Regardless of the fears of some economists in relation to consumer credit, consumer short-term credit is low today in relation to discretionary spending power. Between 1940 and the present, consumer credit expanded four times to a level of 34 billion dollars; but consumer discretionary spending power is presently six times the 1940 level. As to industry, the net corporate long-term debt is half as big in relation to national production as it was prewar. The ratio of corporate profits after taxes to corporate long-term debt has increased from 15% in 1940 to 25% in 1955, while net working capital as a percent of long-term debt has increased from 63% in 1940 to 117% in 1955. Chart 4 shows how long-term corporate debt is declining in relation to production.

Breakdown of markets

To relate the above five factors to markets for plastics, let us consider the markets in turn.

Home building. At present more than 50% of our dwellings are over 30 years old and quite obsolete. In the next decade, we will need 7 million homes to replace those that cannot be satisfactorily remodeled; ½ million new homes to replace houses destroyed by fire, flood, and other causes; 1 million new homes for older people going into retirement; and 8 million homes for the new families that will be formed. The average yearly rate of home building should therefore be in excess of 1½ million units, compared to our recent building rate of 1 million homes a year.

In the 1970's the nation will require new homes at a rate of over 2 million a year.

School construction. By simply applying the

Table I: Breakdown of population by age groups

Age group, years	*1935*	*1940*	*1945*	*1950*	*1953*	*1965*
Population (in thousands), both sexes, all ages	*127,250*	*132,124*	*139,928*	*151,683*	*159,630*	*189,916*
0 to 9	21,959	21,227	23,801	29,619	32,991	37,616
10 to 13	9,941	9,295	8,559	8,986	10,137	15,166
14 to 17	9,652	9,846	9,133	8,445	8,888	13,914
18 to 24	15,961	16,608	16,790	16,014	15,343	20,342
25 to 34	20,275	21,446	22,733	23,926	24,255	22,269
35 to 44	17,713	18,422	19,787	21,570	22,360	24,061
45 to 64	23,946	26,249	28,631	30,837	32,332	39,212
65 and over	7,803	9,031	10,494	12,286	13,324	17,336

birth rate figures to school enrollment, we will need 23% more elementary school facilities in 1965 than we have now, 55% more high school facilities, and 40% more college facilities.

Automobiles. W. C. Flaherty, director of research for Chrysler Corp., foresees a 9 million-a-year new car market by 1965, with around 70 million cars jamming the highways in that year. There are now over 51 million passenger cars on the road. The automobile market is a bellwether in our economy since it is closely tied to consumer credit and to the rising standard of living. It is worthy of note that 69% of today's car owners have no outstanding debt against their cars! Two major pressure factors will be involved in making Mr. Flaherty's prediction come true: a) the need for a second car in 11 million suburban families and b) stricter state traffic control which will, within the next decade, force the scrappage of at least five million cars a year.

Home appliances. According to Roger M. Kyes, vice president of General Motors, 60% of American homes will be air conditioned by 1965, and annual sales of refrigerators and automatic washers will have increased by a million units. Based on current projections, sales of electric driers should double in this period and sales of dishwashers and food waste-disposers should quadruple. An additional factor is the trend toward two refrigerators per family; it is predicted that there will be 10 million families so equipped a decade from now.

The leisure market. As the work week is shortened due to per-man production increase and as the older age group grows in size, the nation is faced with a big growth of the leisure market, which has proved to be far more lush than the non-leisure market. It is all involved with the new "family" approach to living on the part of the American people. It is concerned with small suburban homes, with gardening and do-it-yourself, with family automobile travel, with fishing and small boats, and wading pools and swimming pools. It is conservatively estimated, for example, that 30,000 swimming pools will be built in 1956—three times as many swimming pools as there were in the whole country in 1945.

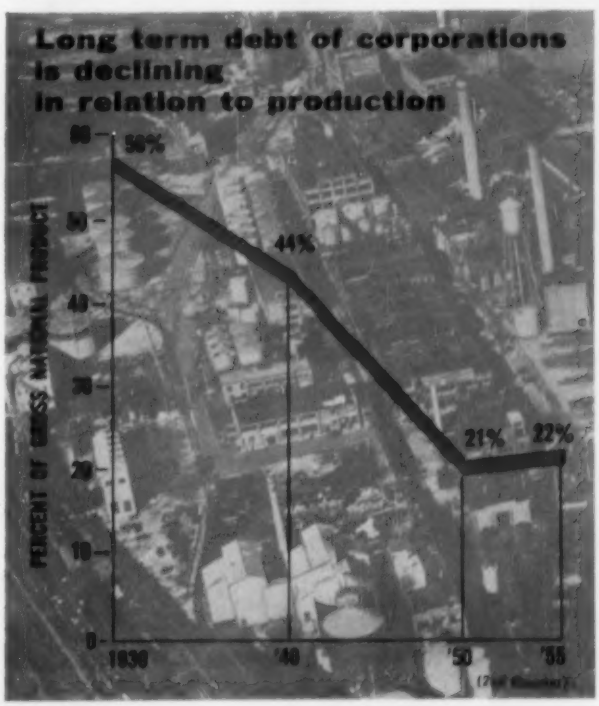
Coming labor shortage?

Standing in the face of these fabulous future possibilities, and particularly as far as the plastics industries are concerned, are two related but most important problems. The first is the obvious fact that, even at present hours-per-week, using present industrial facilities and methods, we cannot hope to produce the goods and services we will need in the next two decades with the predictable size of work force. The second is the continuing shortage of engineering and technical talent.

As to the first problem, with a labor force of 67 million in a total population of 165 million we can and probably will have a gross national product of around 400 billion dollars in 1956. By 1965 the labor force of around only 74 million in a population of 190 million, using today's methods and equipment, will be expected to turn out work that, at today's pace, would require no less than 92 million workers! (See Chart 5.)

Output per man-hour is, of course, increasing. But the increase in productivity per man will have to be far faster in the years ahead than it has been in even the postwar decade. Automation in all its forms is obviously a major answer to this problem. And automation involves plastics in two ways: a) the plastics parts which may be assembled into products untouched in process by human hands as, for example, printed circuits; and b) the processing of plastics into products and components by automa-

CHART 4



tion. It is a terrific challenge to the plastics industries and to end users and prospective end users of plastics.

More technologists needed

While our population is increasing at a far greater rate than our labor force, many of the answers to productivity rest in the hands of a relatively few engineers and technologists. The technological changes required and in prospect cannot be accomplished in time without the development of more technicians, especially in plastics—which are related as closely to our national defense as they are to our consumer economy.

Fortunately, this picture is improving. In the academic year 1955-1956 engineering school enrollments were 243,198 or 50% over the 165,637 enrollments in the year 1951-1952. In all industry in the ten years from 1946 to 1955 over 1,600,000 man-years were devoted by scientists and engineers to technological research and development; this compares with 837,000 man-years so devoted in the ten years from 1936 to 1945.

If the number of research people increases on the average of only 12,000 a year during the next decade, this country will have more than 330,000 research engineers and scientists in 1965 in all, and the average number of scientists and engineers engaged in research in that time will be 70% greater than during the last nine years.

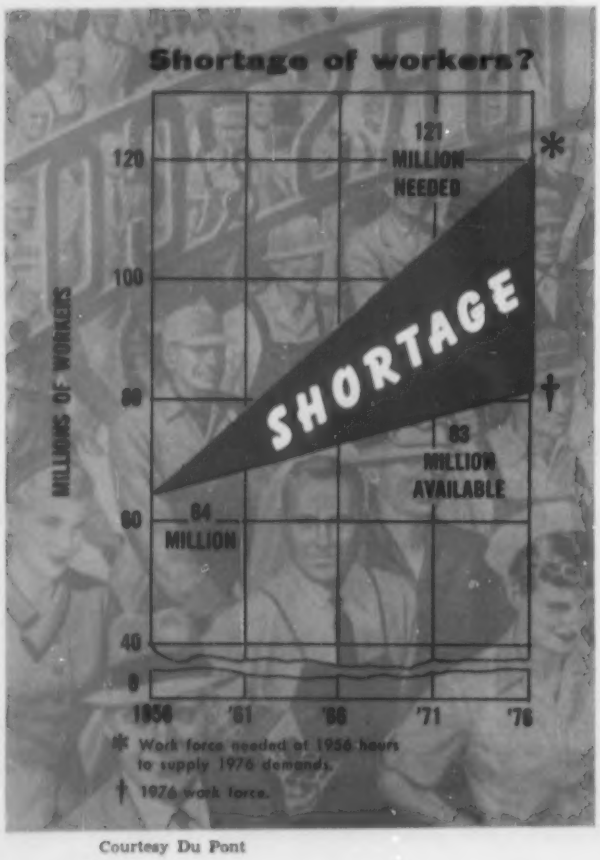
Challenge at all levels

From all the foregoing, it is apparent that markets for most products are bound to be bigger in the years ahead. Should the trend toward greater percentages of plastics as components in all end products continue at even its present pace, the market opportunities of plastics materials and products will grow even faster proportionately than the rate of general increase.

As will be apparent from a study of the other sections of this issue, there need be no long-term shortages or dislocations in material supply. The problem of the development of technologists to serve the industry is being rapidly overcome, as pointed out above. The problem of future labor shortage in relation to production in all industries merits research by all plastics executives from material maker through machinery manufacturer and processor to designer.

And this problem, serious as it appears to be, is small in comparison to the opportunities for plastics in the years ahead.

CHART 5



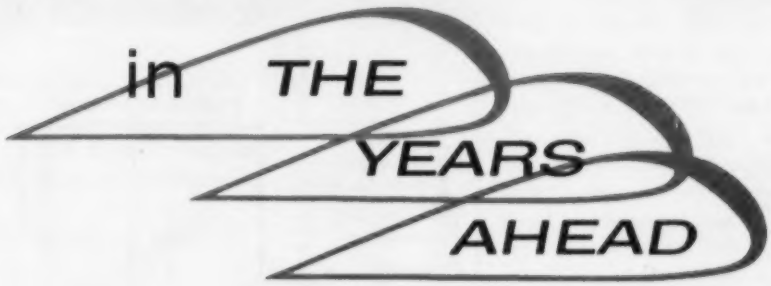
Courtesy Du Pont

Acknowledgments

Research sources for this article were: "Potential Economic Growth of the United States During the Next Decade" from the Joint Committee on the Economic Report of the 83rd Congress of the United States; "America's Needs and Resources," survey by the 20th Century Fund; The 1952 Report by the President's Materials Policy Commission directed by William Paley, President of Columbia Broadcasting System; The Economic Report of the President of the United States, January 1956.

The editor wishes especially to thank the following for their kind cooperation: Dr. Grover W. Ensley, Staff Director, Joint Committee on the Economic Report; Dr. Sumner H. Slichter, Lamont University Professor, Harvard University; Arno H. Johnson, Vice President and Director of Research, J. Walter Thompson Co.

Plastics materials



If consumption of plastics increases as much in the next five years as it did in the past six there is likely to be a wild scramble to find the raw materials that will be necessary to feed the maw of the machines from which plastics emerge.

Day after day the demand from all directions for basic chemicals—sulfuric acid, chlorine, benzene, ethylene, acetylene, etc.—goes on and on. If these chemicals were not so important to so many industries, the plastics industry wouldn't need to worry about its raw material supply. But the total demand for chlorine, as an example, is such that no one can be sure at any given time whether or not there will be enough to go around.

Chemical company officials don't care for that kind of talk; they point with pride to never-empty supply lines and are quick to call attention to any unused capacity that may exist. But, nevertheless, shortages have made far more important news than surpluses ever since 1942.

However, there is another side to the picture. Hardly any one in plastics expects as great increases in use in the next five years as in the past six. Another 30% increase, such as took place in 1955, would be considered as much of a phenomenon as a snow storm in Miami on July 4th. The market for plastics products is by no means saturated, but it is difficult to believe that the public can soak up plastics at such a pace over a long period. The field for new products was wide open following consumer starvation during World War II and the Korean outbreak, but that starvation is rapidly changing to just normal hunger. In addition, there is more competition from other materials, such as aluminum and better ceramics, to say nothing of the steadily growing competition between various plastics materials themselves.

Yet there are responsible business leaders like Harlow Curtice of General Motors, who predict great expansion of all business for an indefinite number of years. The chemical industry itself is spending well over $1 billion a year for new facilities. Growth of all chemicals for more than 25 years has been 10% a year, compared to 3% for all industry. The crystal ball has a rosy glow. Barring a war or a globe-shattering depression of catastrophic dimensions, business should continue to expand at a good, steady pace. The big question is: how much?

The plastics expansion has been headed

Consumption of plastics and synthetic resins grew from around 1.4 billion lb. in 1949 to almost 3.5 billion in 1955. It is possible that the same rate of increase could be maintained and another 2 billion lb. added by the end of 1960, but few, if any, analysts believe that the next five years' growth will equal the last six. Consequently, the 1960 "hunch" estimate in the table accompanying this article (see next page) is deemed more realistic. It is based on years of experience in interpreting industry statistics; recent interviews with executives whose job is to plan for the future; allowance for losses in some markets and gains in others. It is strictly a "hunch" that could be knocked cock-eyed by unforeseen developments or happenings that can always upset the best-laid plans in the chemical industry. But under normal circumstances this 1960 sales volume estimate should be rather easily attainable—it is what the trade would call "a conservative estimate."
R. L. Van Boskirk

primarily by the newer materials, but it is significant that the older materials such as the cellulosics and phenolics have shown a 60 to 89% gain in the past six years. That they stayed in the running by enlarging their old markets and creating new ones augurs well for the future of newer plastics. The newer materials have scarcely had time to find all their possible outlets and there is no worry as yet about stalemates created after a product has been thoroughly tested for every possible application. In other words, the older plastics must hunt for new applications; the newer plastics are hunted by prospective customers.

Unorthodox statistics

The growth of the older plastics in comparison to the new is well illustrated in the table on this page. This table is perhaps one of *the most unorthodox statistical summaries ever printed*, but when dealing with futures in comparatively new products, unorthodoxy sometimes makes more sense than inflexible graphs and charts built on established theory or past performance.

The table shows the volume of business in the plastics industry at the beginning of 1950, at the close of 1955, and presents estimates on what the situation could be at the end of 1960. Literally, it covers activities of an 11-year period, since the full years of both 1950 and 1960 are included, but the chief purpose is to "guess" at how business will be at the end of 1960 rather than at the beginning of that year.

The column showing growth based on the same percentage growth in 1956-1960 as in 1950-1955 is obviously an unscientific estimate since percentage

Ten years of plastics materials

Production and sales for last five years

	1949				
	Production[a]	*Sales*[a]	*Production*	*Sales*	
Cellulosics:	—	—	91,000,000	87,000,000	
Continuous sheets	16,000,000	15,000,000	—	—	
Molding and extrusion	56,000,000	54,000,000	—	—	
Phenolic and tar-acid resins:	—	—	291,000,000	249,000,000	
Molding materials	130,000,000	117,000,000	—	—	
Urea and melamine resins:	—	—	134,000,000	129,000,000	
Laminating and molding	46,000,000	45,000,000	—	—	
Styrene and styrene derivative polymer and copolymer resins:	—	—	240,000,000	228,000,000	
Molding materials	185,000,000	179,000,000	—	—	
Vinyl chloride and copolymer resins	—	—	205,000,000	200,000,000	
Other vinyls	—	—	—	—	
Alkyd resins	—	—	316,000,000	178,000,000	
Rosin modifications	—	—	60,000,000	50,000,000	
Polyethylene	—	—	30,000,000	30,000,000	
Acrylics[c]	—	—	25,000,000	25,000,000	
Nylon	—	—	—	—	
Epoxies	—	—	—	—	
Polyester reinforced	—	—	—	3,000,000	
Coumarone-indene and petroleum resins	—	—	—	90,000,000	
Polyurethane Flexible foam	—	—	—	—	
Fluorocarbons	—	—	—	—	
Alkyd molding	—	—	—	—	
Polyester Film (Mylar)	—	—	—	—	

[a] Most 1949 and 1955 figures are taken from U. S. Tariff Commission reports.
[b] This column shows total that would result if these materials should increase in the same percentage in the next five years as they did in the last six. Materials that had extremely small volume in 1949 are not included.
[c] These columns represent certain classifications that are separated from main groups because of particular interest in their portion of the total.

progress and possibilities*

with estimated consumption for 1960

	1955				% Increase sales 1949–1955	Amount sold in 1960 at same % increase[b]	Hunch estimate for 1960[c]	Hunch % growth
	Production[a]	Sales[a]	Production	Sales				
	—	—	145,000,000	142,000,000	60	230,000,000	200,000,000	30
	34,000,000	34,000,000	—	—	130	75,000,000	65,000,000	90
	92,000,000	90,000,000	—	—	65	150,000,000	110,000,000	20
	—	—	506,000,000	471,000,000	90	890,000,000	660,000,000	40
	211,000,000	196,000,000	—	—	65	325,000,000	250,000,000	28
	—	—	313,000,000	293,000,000	125	665,000,000	390,000,000	30
	95,000,000	90,000,000	—	—	100	180,000,000	130,000,000	45
	—	—	610,000,000	559,000,000	145	1,300,000,000	850,000,000	50
	422,000,000	381,000,000	—	—	110	800,000,000	650,000,000	70
	—	—	557,000,000	527,000,000	160	1,300,000,000	950,000,000	80
	—	—	145,000,000	137,000,000	?[f]	?[f]	250,000,000	80
	—	—	429,000,000	229,000,000	35[d]	580,000,000	555,000,000	30[d]
	—	—	139,000,000	124,000,000	150	305,000,000	175,000,000	40
	—	—	420,000,000	346,000,000	?[f]	?[f]	1,100,000,000	180
	—	—	—	50,000,000	100	100,000,000	125,000,000	150
	—	—	—	25,000,000	?[f]	?[f]	50,000,000	100
	—	—	—	22,000,000	?[f]	?[f]	90,000,000	300
	—	—	52,000,000	45,000,000	?[f]	?[f]	90,000,000	100
	—	—	260,000,000	258,000,000	185	735,000,000	350,000,000	35
	—	—	—	5,000,000	—	—	150,000,000	?[f]
	—	—	—	2,000,000	—	—	7,000,000	?[f]
	—	—	—	7,000,000	—	—	10,000,000	?[f]
	—	—	—	5,000,000	—	—	15,000,000	?[f]

[a]This is thought to be a more realistic estimate based on past experience, on interviews with industry analysts, and/or on possible loss or growth of certain markets.

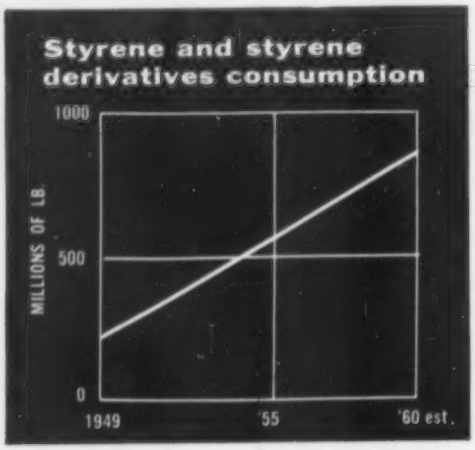
[b]This percentage is based on production rather than sales because of large captive production.

[c]Does not include acrylonitrile.

[f]A figure here would be pointless since 1949 production was either small, unknown, or non-existent.

growth after an industry has reached volume production is generally much smaller than percentage growth during the first few years of existence. Furthermore, it is a five-year growth compared to a six-year growth. It is not likely that the industry will grow in this proportion, but it is a goal to shoot at.

The "hunch" estimate was devised because the estimate which would have the next five years growing as fast as the last five (or six) seemed too good to be true. There is no scientific projection or slide rule sleight-of-hand involved in this figure. Its derivation would make a professional statistician shudder with horror. It is just what it is called: a "hunch." That hunch is based on years of experience working with plastics figures and charting their trends, as well as on comprehensive interviews with various executives whose job is to plan for the future as well as today, all veterans in plastics. Careful weight was also given to possible new markets, possible loss of present markets, and competition between plastics themselves, such as the situation that may arise when the new polyolefin plastics arrive on the market in quantity.



Furthermore, allowance is made in this "hunch" column for the possibility that general business will not increase as much in the next five years as it did in the last six. Perhaps the best estimate for 1960 plastics consumption lies somewhere between the two estimates given in the table. In several cases, polyethylene, nylon, etc., no estimate is made for percentage growth in the next five years, since the materials grew from such a small volume in 1949 that percentages mean little.

Following is the reasoning from which the figures in most of the "hunch" estimate column are derived, together with comment on changes in conditions that could make a great difference in what happens by 1960.

Cellulosics

Cellulosics growth has come entirely from cellulose acetate and cellulose acetate butyrate. The biggest percentage growth is in both cast and extruded continuous film. Sheeting has also made a modest growth. Although more than half of the film and sheeting is used for purposes other than packaging—such as electrical tape—the packaging and display fields are expected to take ever-increasing quantities. Acetate is king in the skin and blister pack field and in many other types of vacuum formed packages and signs. Butyrate film, too, is growing rapidly in such applications where stronger film is desirable — hardware, for example. It has also made quite a splurge as an outdoor sign material. The big increase expected for film and sheeting is due primarily to ever-growing self-service retailing where the cellulosics' clarity and toughness is ideal.

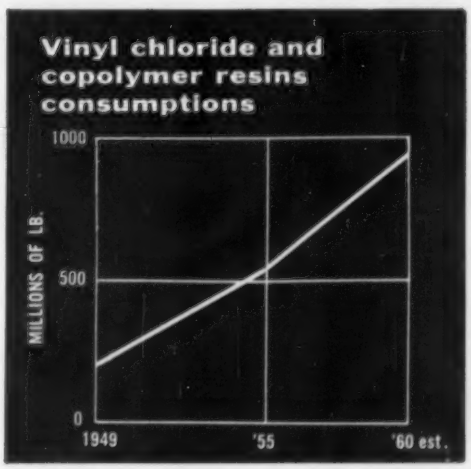
Molding and extrusion material growth is not expected to be large; some think it will be lucky to hold level with present consumption. Competition from lower-cost plastics has hindered the growth of cellulosic molding materials, but there is no sign that the price differential will change much. Butyrate pipe has been somewhat of a disappointment so far as volume use is concerned, but may yet become the largest outlet for the material. New and improved materials, such as cellulose propionate (Forticel) and a higher-acetyl acetate (Hercocel-W), with better surfaces and heat resistance, could broaden the market to some extent. But, up to now at least, together with butyrate, they have been competing in the same fields. They now range in price from 55 to 62¢ which discourages any ideas about a 100 million-lb. annual sales.

Phenolics

The growth in phenolics is based largely on uses other than molding material. Molding powder usage is unpredictable; if something like the won and lost television cabinet application should come along, the consumption figures could be considerably altered. Portable phenolic television cabinets, for example, are a good prospect for the near future, but competition has eaten into several long-time appli-

cations and development of new uses are few and far between. However, the ever-expanding electrical industry takes and should continue to take ever-increasing quantities of phenolic parts, enough to more than overcome possible losses in other applications. Nothing startling has been announced concerning new resins although there are always rumblings about a colored phenolic; however, it is feared that cost of any such material would more than offset the advantages. Glass, flock, and mineral-filled phenolics have broadened the base, but they can't be foreseen as big-volume promoters. Molders have benefited from new and faster molding compounds over the past two years, but that development hasn't helped volume to any extent. It's impossible to foresee another 67% gain in molding material in the next five years, but 30% is within reason, based on the growth of phenolics-using industries.

The possible growth of other phenolic resins is much more promising. Uses for resin in decorative laminating, insulation binder, and plywood are getting larger year by year. Such things as shell molding and Microballoons are in their infancy. Insulation bonding is already over 50 million lb. and still growing—the limit is unguessable. Resins for plywood are over 40 and could easily go to 50 million pounds. Laminating resin has come from 40 to almost 70 million lb. since 1949 and decorative laminates still have vast horizons. Shell molding resins will almost certainly get up over the 60 to 70 million-lb. figure predicted years ago. And allowance can always be made for one or two items that aren't even thought of today. A 700 million-lb. guess for all phenolics in 1960 might even be conservative. Long-range guesses on phenolic have almost always been underestimates in the past—the stuff always seems to have a way of confounding both its most optimistic and pessimistic proponents.



Urea and melamine

The urea and melamine increase since the beginning of 1950 is quite surprising to anyone not completely familiar with that branch of the industry. It could be even more surprising by the end of 1960. There are several possibilities that could finally develop after years of what some critics in the industry call "dilly-dallying." Who would have guessed in 1949 that resin content of urea glues would increase from about 40 million to over 100 million lb. in 1955—that textile- and paper-treatment usage would increase from 23 million to over 60 million lb. of resin? Every one of these uses is growing nicely—wet-strength paper is a good example. Any or all of the above applications could grow more in the next five than it did in the last six years. Urea as a binder for waste wood is most promising, too, but real big volume is probably more than five years away.

Estimated growth in molding powder and laminating is largely based on melamine possibilities, but if the producers ever get around to introduction of a lower-cost color compound, urea, too, might show some extraordinary gains. But melamine, even at its premium price, is a different story. Some 25 million lb. was thought to have been molded into dinnerware in 1955 and the market can absorb much more than that. Melamine dinnerware was scarcely started in 1949. There are many other possibilities, such as aerosol containers and hardware for bathrooms. A lower-cost melamine made directly from urea crystal is a possibility.

Melamine laminates are constantly broadening in use from kitchen counter tops to other types of furniture and paneling. These are big potentials, even though a small amount of melamine goes a long way.

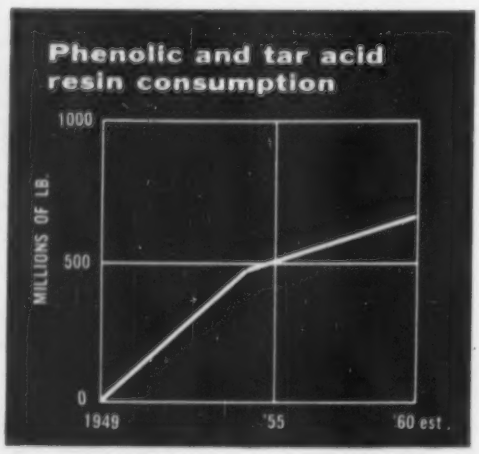
Styrene resins

There are more differences of opinion about the future volume of styrene-type resins than about any other big-volume plastic on the market. Even the producers themselves disagree. The conflict stems largely from different ideas concerning how much competition there will be from other plastics, particularly the new polyolefins and the various materials used in the surface-coating field. But if increases over the next five years are at the same rate as those of the last six, styrene and its copolymers will certainly remain leading

volume materials—maybe *the* leader—and perhaps they will reach the billion-pound mark before any other.

It isn't impossible to believe that styrene resin volume can be increased another 130 or 140% in the next five years in view of its amazing performance since 1949—but that isn't likely. For one thing, the 145% increase shown in the table is overloaded in the styrene-butadiene latex resins classification which came from less than 20 million lb. in 1949 to 85 million in 1955. No such percentage increase should be expected in the next five years, but styrene producers do expect a continuous improvement. There are ever-expanding possibilities in development of copolymers for paints—an exterior paint, a solvent-type paint, styrenated alkyds for paint, and various others. In addition, the use of styrene-butadiene latex in paper treatment and wax could grow much more than it has up to now. However, there can be severe competition from vinyl acetate and acrylic emulsions in the paint field. Possibly a new olefin or some new copolymer will move into the field and obsolete one or all three of these resins, but that accomplishment isn't likely to happen in the next five years.

The high styrene-butadiene resins (80-20) used for shoe soles and rubber reinforcement in floor coverings, as well as ion exchange resins, will undoubtedly show a small percent gain each year, based on past performance. The 250 million lb. allowed for other than molding powder uses in the "hunch" estimate for 1960 should probably be divided about half and half between coatings and these miscellaneous types.



In allowing a 600 million-lb. total for styrene-type molding material in 1960, a growth of from 40 to 55 million lb. a year is anticipated despite the fact that polystyrene increased 70 million lb. in 1955. To say that polystyrene will never grow that much again in a single year is dangerous indeed but, on the other hand, such a terrific pace apparently can't be maintained forever. The first quarter for 1956 is estimated at a little over a 400-million-lb.-a year rate or a 20 million-lb. annual gain over 1955.

There has been much talk about potential losses in toys and housewares, but figures don't bear out the rumors. It is true that the polystyrene percentage in these fields has dropped, but total polystyrene poundage in both fields remains high because total poundage of both housewares and toys in all materials has continued upward. High-impact material plus the demand for low cost and brilliant color insures polystyrene a good portion of these markets for some years to come.

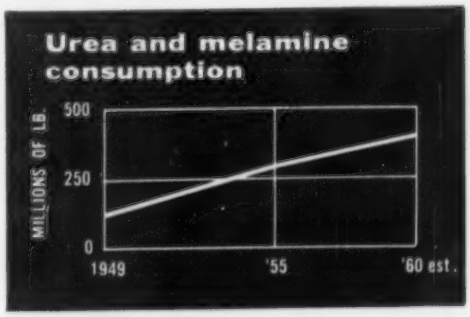
A constantly increasing market for wall tile is a bright spot for polystyrene. The 1955 total may have been as high as 80 million pounds. It could go to 100 million lb. in 1956 and continue upward for some time. It is now outselling ceramic tile, but only 2% of the total wall area in buildings is as yet plastic covered.

Packaging applications of styrene-type materials are growing like mad. The recent Atlantic City Packaging Show offered visible evidence. Throw-away cups and containers were all over the place. And vacuum-formed containers made from high-impact sheet, produced from a continuous operation starting with extrusion pellets, point to a new era for styrene-type sheet. And as a companion piece to packaging, vacuum-formed signs shown at the Point-of-Purchase show indicate that styrene-type sheet has moved into another big market. Heretofore, most such sheet has gone into refrigeration—polystyrene's biggest market so far—but other applications are now mushrooming.

Doubters frequently offer the criticism that the new polyolefins, which are more rigid than conventional polyethylene and tougher than polystyrene, will take over the greatest portion of the polystyrene market in toys, housewares, and packaging, but that will have to be proved. At present prices, and considering specific gravity, polystyrene is still 5 or 6¢ a lb. cheaper, has color advantages, is more rigid, and is superior for transparency when the latter is desirable. That price differential may

become smaller as polyethylene (or polyolefin) comes down in price, since it isn't likely that polystyrene can decline from present levels; but polystyrene producers still have other good cards to play.

General-purpose crystal polystyrene is still a basic big-volume material because of price, rigidity, transparency, and easy molding properties, but each producer now has from 8 to 11 or more formulations on the market, each tailored to do a certain job. The high-impacts are best known and now account—or soon will—for more than half of all production, but even the high-impacts are varied to meet the need of the molder. Extruded modified polystyrene sheet has been on the market for only five years, but the extruder can get a different formulation depending upon whether he wants it for a refrigerator or something else. Extruded oriented film is available that is pointed straight at the acetate film market as well as lighting panels and other uses. Another type polystyrene film should be available before this five-year period is over. Perhaps even a transparent high-impact material will some day be available.



Greater heat resistance has been built into styrene materials. General-purpose material limits are 155 to 178° F., but special materials can be obtained that will withstand from 212 to 225° F. Not much higher is needed unless it is for a baking dish; the next step may be a range of from 250 to 270° F., so that food can be processed in a polystyrene container.

Still another good prospect for the next five years is a clear polystyrene sheet or film that can be laminated over other plastics sheets to give a better surface. Such a material might even be used for wall covering panels.

Not to be forgotten among the brighter polystyrene prospects is foam for thermal insulation. If this market grows in building and vehicle insulation as expected, the volume in 1960 could be in the tens of millions of pounds.

The styrene copolymer molding materials haven't grown much in the past five years. Some 20 to 30 million lb. were used in 1955, but producers are expecting a bigger volume in the next five years. Not much allowance is made for growth in the "hunch" estimate column since no evidence could be found of possible great expansion of markets until cost is reduced more drastically. However, there is a styrene-butadiene sheet material without rubber modification now beginning to make headway. It still costs more than rubber-modified polystyrene sheet, but it competes with most other rigid plastics sheets and could build up considerable volume by 1960. There is even the possibility of impact materials made from styrene and butadiene that will be *clear*, transparent, and tougher than anything available today. That "hunch" estimate for polystyrene could be low because of the possibility of competition from other molding and extrusion materials. But they'll have to be mighty good to compete with all the advantages that styrene-type materials have to offer in the fields for which they are recommended. If the styrenes are to be hurt by the new polyolefins, the impact is more likely to be severe after 1960 than before.

Vinyls

Vinyl chloride consumption growth has been double-barrelled: new products keep popping up and established products mushroom almost fantastically. And if an application fails, something else develops to more than replace the lost poundage.

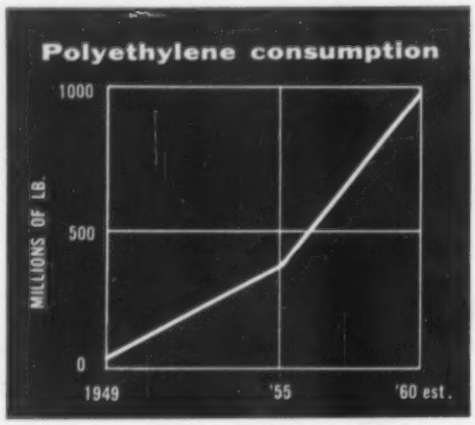
Producers have contended that the Tariff Commission's Annual Report figures have always been from 10 to 20 million lb. higher than actual consumption figures due to "lost" resin in inter-company transfers, duplication, and errors in reporting, but that difference is of slight importance in such a total. The big export market of 35 to 50 million lb. will probably dwindle since other countries are building up their own supply lines, but there are no other signs of permanent losses in established markets.

The 100 million-lb. or more increase in vinyl chloride consumption in 1955 over 1954 is generally considered an unusual performance that isn't likely to happen again, but the same thing happened in 1950. At that time the increase was 60 percent. In 1955 the percent increase was only 30. In the meantime, annual percent-

age increases ranged from 5 to 14. The big over-all five-year percentage growth was largely due to the big 100 million-lb. or more boosts in 1950 and 1955.

All these figures ignore imported vinyl resin of which 25 or 30 million lb. was used in the U. S. in 1955.

In the first quarter of 1956 the industry was operating at a 550 million-lb. annual rate, exclusive of imported resin. How long this sort of increase can keep up is not an answerable question. The big increase in 1950 was sometimes credited to the effect of the Korean War—the 1955 increase to a drop in resin price from 37 to 27 cents. There are many in the industry who differ from that reasoning—they say the increase in volume was certain to come anyhow because the market was there to take.



Producers have so far kept capacity well ahead of consumption except for two or three grades of specialty resins.

Present capacity for vinyl chloride monomer production in the U. S. is thought to be well over 750 million lb., with polymer capacity close to 700 million and rapidly growing. Most of the major producers are currently adding to their capacity. Several processors of vinyl products are also building small vinyl polymer plants because they feel that they must have an integrated operation in order to compete. But since the margin of profit between monomer and polymer has now shrunk to such small proportions, and will shrink more if competition gets tough, it is believed that anything smaller than a 50 million-lb. polymer plant is of questionable economic value. This theory will undergo thorough testing during the next five years.

The amount of raw materials needed if the vinyl chlorides flirt with that nearly billion-lb. figure in 1960 is something to contemplate. Such an amount of vinyl would theoretically require 568 million lb. of chlorine. Chlorine uses seem to expand much faster than the general economy and if an emergency should arise, the vinyl industry could expect chlorine to be placed on allocation.

The present vinyl chloride monomer capacity of over 700 million lb., exclusive of Allied, would require an estimated 220 million lb. of acetylene and about 125 million lb. of ethylene, if operated at capacity. About 0.46 lb. of acetylene is required for a pound of vinyl chloride. The total consumption of acetylene in 1954 was around 600 million lb., of which 340 million lb. were for chemicals. About 100 million lb. were used for P.V.C. in 1954. Total capacity for acetylene was thought to be nearly one billion lb. in the U. S. and over 1.5 million in Canada. About ⅓ of the acetylene used for chemicals was for P.V.C. in 1954. It's difficult to estimate how much more acetylene would be needed if the P.V.C. industry grows to 900 million or 1 billion lb. because some of the expansion plans call for ethylene instead of acetylene. Unless other demands for acetylene, such as neoprene, vinyl acetate, or acrylonitrile, reach unbelievable heights, there would seem to be no worry about an acetylene supply for vinyl chloride in 1960, especially in view of the ever-increasing proportion of ethylene that is being used for vinyl production.

Practically all of the established vinyl products are scheduled for increased growth over the next five years. Wire coating, floor coverings, upholstery, and surface coatings are all on the upswing. Market analysts have ceased trying to put a ceiling or a leveling-off spot on them because all past forecasts have been too low and no one knows how far they can go. Upholstery in particular is booked for steady growth since the public is now educated to vinyl for that purpose. Recent developments of "breathable" upholstery have added zest to the expected increase. In addition to the spread in household, office, and automotive upholstery, most of the restaurants in the country are now ready for a re-do, and vinyl is expected to corner a large portion of that volume market for itself.

Development of new products already under way will probably add substantially to the vinyl volume. Wall coverings could some day be even more important than floor coverings from a volume standpoint. Film laminated to

fabric, metal, wood, and other plastics is growing like the family of an active rabbit. Possible use of vinyl chloride for fabric treatment looks promising. It will give stiffness to denim for women's skirts; it may make men's suitings more pliable, especially in unwoven fabrics. Many synthetics are being tried in both conventional and unwoven fabrics, but there is no certainty as yet as to whether or not vinyl chloride will have an important place in this competition.

Molded elastomeric products

The lowered cost of vinyl is already starting to open up new markets for molded elastomeric products where it may well compete with other plastics. Molders will become better acquainted with its possibilities when they become aware of its lower price possibilities.

Increasing use of plastisols is certain to add many pounds to over-all vinyl consumption. Recent announcements indicate that molded plastisols may soon be made with either a hard or soft surface, as desired; toys in particular will benefit. The same idea applied to vinyl foam or sponge should improve the price structure in that highly cost-conscious market. One producer estimates a 20 million-lb. vinyl foam and sponge market; another estimates a 100 million-lb. volume.

Sponge, as differentiated from foam, is also looked upon as a market with great potentialities, especially for flotation and impact applications. The latter applies to crash pads in all industry as well as to packaging. In five years' time it is entirely possible that crash pads could burgeon into an unbelievably big market potential.

Plastisol for coated fibrous glass screen cloth has grown so fast that compounders don't even like to talk about it. And still another use is in plastisol-coated nylon tarpaulins which one processor says will take over 70 or 80% of the coated canvas business by 1960.

One of the most hopeful, biggest volume uses for the future is unplasticized vinyl. Today it is merely a trickle compared to what is expected. Biggest present uses are for lighting fixtures, maps, signs, and pipe. The latter may eventually have competition from the new olefins, but vinyl technicians say that their pipe exhibits better aging characteristics and is less affected by creep at moderately elevated temperatures.

Eventually, unplasticized vinyl sheet and extrusions should play a large part in building construction. Right now such uses are handicapped by codes, lack of know-how, little promotion, and tradition. Nobody will guarantee a vinyl-sheathed house to last 30 or 40 years as they do a brick or lumber house. Consequently, vinyl applications move slowly. First will be extruded shapes and parts such as window frames, sliding doors, downspouts, and gutters. After these have made their mark, bigger parts such as panels and roofing may come.

Some of these things may take on sizable proportions before 1960, but it won't be easy to establish vinyl in this field. The builder will have to compromise—vinyl won't give him the clarity of glass nor the strength of steel, but it will give him non-corrosion, no need for paint, and other properties to assure a worthwhile job. Selling that compromise is going to be quite a task. Consequently, it is probable that the big increase foreseen for vinyl in structural uses will come about in the 1960 to 1970 decade.

Up-graded resins coming

All of this progress in vinyl chloride resins is going to be accompanied by constantly improved resins. The producers are seeking faster forming, higher heat resistance, and use of little or no plasticizer—perhaps even a heat resistance that would make it possible for the resin to be used for high-voltage power line insulation.

There are several avenues of approach to these up-graded resins. Most frequently mentioned are new copolymers, but it's difficult to guess what they will be. Vinyl stearates, acrylates, and acrylonitrile have been often mentioned as co-monomers with vinyl chloride. The newer vinyl esters when used as copolymers give properties of flexibility that look interesting and lead toward the goal of less plasticizer. But any new vinyl copolymers that make a real big hit in the next five years will probably be something that has had no publicity up until now.

Perhaps something big will develop from graft or block polymers. The more familiar copolymers are formulations in which various materials are "thrown-in" together. In the graft operation, various polymers are figuratively built one on another—like building a methacrylate polymer on top of a vinyl polymer. In polyurethane, a short-chain polymer is built into a long-chain polymer. The polymers are built to produce some par- (*To page* 356)

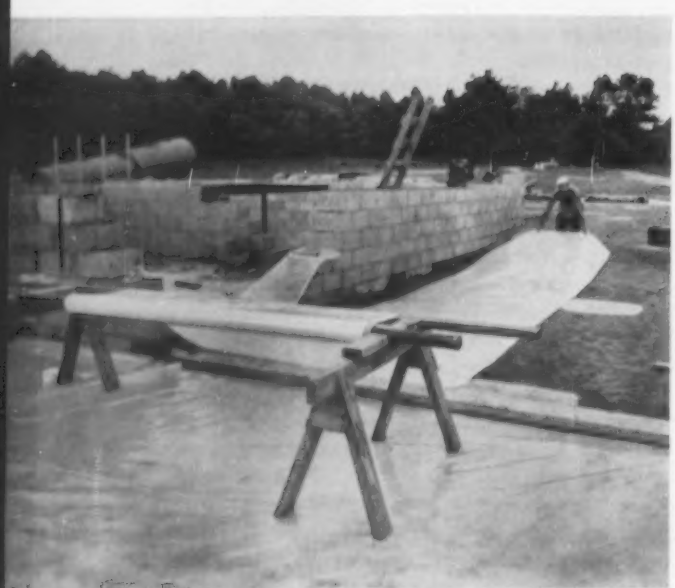
Plastics applications

In the aura of healthy optimism which today surrounds the American economy, new influences are being brought to bear on our society which indicate a bright future for plastic product development.

As outlined in the survey starting on p. 150, the pattern of living in America will undergo some basic changes. The total national output is rising . . . personal incomes are on the increase . . . more products are on the way to meet swelling markets . . . merchandising practices are being overhauled . . . automation has become the key to production.

To meet the challenge thus being set up in our economic system by these new forces, the plastics industry has geared itself for an aggressive program aimed at broadening the bases of application. It is the purpose of the following survey to review the product developments arising out of this program and to anticipate the effects they may have on future volume sales of plastics materials.

Building



Booming building industry is expected to find increased use for polyethylene film moisture vapor barriers. (Photo, Bakelite Co.)

"In the next decade, we will need 7 million homes to replace those that cannot satisfactorily be remodeled, ½ million new homes to replace houses destroyed by fire, flood, and other causes, 1 million new homes for older people going into retirement, and 7 million homes for the new families that will be formed."—p. 152

Recent radical changes in architectural concepts have focused the attention of the building trades on plastics and potential plastics applications.

For the plastics industry, this marks the construction field as one of the most important potential markets in the American economy. Between now and 1965, about 1½ million homes will be erected yearly. By 1965, the annual investment in housing will have topped $15 billion—with an additional $2 billion being spent for major home modernization and improvement. And by the 1970's, houses will be going up at the rate of 2 million a year.

Feeding this hungry giant is going to require enormous amounts of many different materials —and the plastics industry is slated for a major share. Each new house that goes up is a poten-

in THE YEARS AHEAD

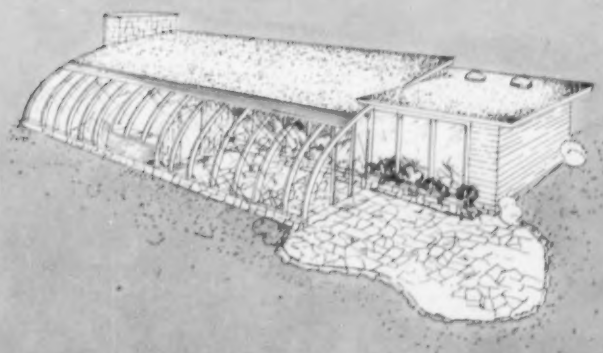
tial market for plastics building applications that have already proved themselves—wall coverings, flooring, upholstery, glazing, paneling, etc. In the area of plastic wall tile, alone, it is estimated that annual consumption for residential use will be some 200 million sq. ft. by 1960.

To achieve really effective penetration of the construction field, however, the plastics industry has set its sights on an entirely new sphere of application—that of structural and semi-structural units—and it is here that the most dramatic impact of plastics progress is anticipated.

The subtle influences that are today shaping the destiny of American housing all point to an increased use of plastics in tomorrow's building design. The growth of family living and the wholesale move to the suburbs, for example, have placed pressure on the architect for easy-to-erect, low-cost housing embodying such esthetic and functional features as spacious and unobstructed areas, mobile units that can easily be re-arranged to satisfy changing living conditions, flexible mechanical and electrical equipment, and the integration of interior and exterior areas of the house, popularly referred to as "indoor-outdoor living."

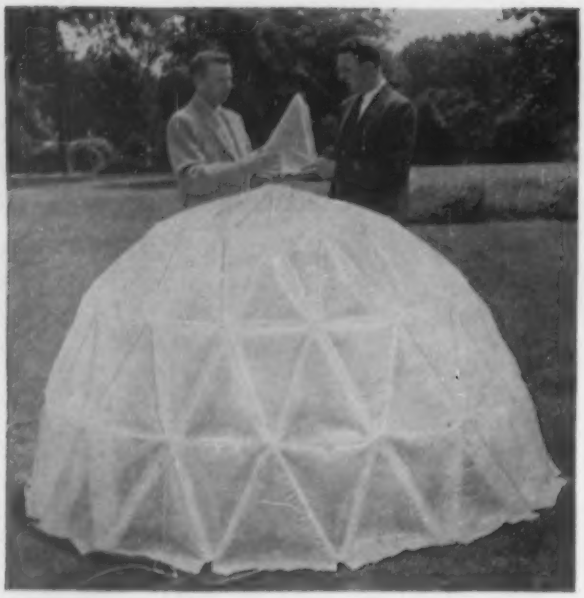
Keeping these factors in mind, what will the House of Tomorrow look like and how will plastics be involved? On the basis of a study into the subject of plastics in housing conducted by the Department of Architecture of Massachusetts Institute of Technology under the sponsorship of the Plastics Div. of Monsanto Chemical Co., and on supplemental work done in the field, the plastics House of Tomorrow might conceivably be constructed in this manner:

To provide freedom currently being sought by architects in structure and building form, the roof can be made of plastics sandwich materials (e.g. reinforced plastics skins with a phenolic-impregnated paper honeycomb or foamed plastics core) curved so that it can span considerable distances and permit primary structural members to be spaced further apart. Within the unobstructed living space thus provided, non-fixed, lightweight plastic sandwich



Structural and decorative plastics applications (list, right) based on current architectural requirements are put to work in design of proposed "all-plastics house." (Sketch by S. Muss Minter for Artmor Plastics)

Polyethylene film barrier under floors and roof
Styrene foam perimeter insulation
Resin-paper laminated hot-air duct
Vinyl tile
Nylon or saran carpeting
Foam (polyurethane or vinyl) carpet cushioning
Vacuum formed and supported vinyl wall coverings
Vinyl-clad doors, exterior
Supported vinyl folding doors, interior
Decorative laminates for counters, etc.
Luminous ceilings of vinyl, acrylic, or styrene
Formed acrylic skylights
Corrugated polyester-glass laminate panels for carport roof and curved sunshade
Acrylic pans in entry wall
Extruded vinyl weather stripping
Acrylic shower enclosures
Sprayed-on vinyl weather coating
Polyethylene pipe for water line
Formed vinyl or styrene copolymer panels for drape cornices
Nylon and/or styrene copolymer valves for plumbing
Resin laminate structural beams
Spouting and gutters of PVC



Indication of "things to come" in building are inflatable polyethylene film "bricks" which assemble into dome structures. (Photo, Univ. of Illinois)

panels will serve as movable room separators. The outside walls can be made up of translucent skins bonded to translucent foams to combine thermal insulation with maximum light transmission. Glazing panels of acrylic or translucent laminate materials also can be used to intensify the effect of spacious, light-admitting walls. Floor areas will also be constructed of sandwich panels with molded-in air-conditioning ducts. To provide flexibility in lighting, luminous ceilings of vinyl, acrylic, or styrene will be used, thus permitting space arrangements to be changed without limitations imposed by accessibility to electrical outlets. Along the same lines, electronic room cooling and heating units can be incorporated in wall or ceiling panels. Modular units, such as bathrooms in which plumbing and electrical fixtures are molded in as parts of wall, floor, and ceiling, will make it possible to vary room design by simple re-arrangement of two or three units. Thus, living space can be (*To page* 374)

Transportation

". . . In 1955, 85 million Americans traveled away from home . . ."—Tide, March 24, 1956

As the pace of daily living accelerates, as business covers broader fields of operation, as vacation travel booms, modern transportation facilities are being taxed to provide the ultimate in speed and service at minimum cost to the passenger. To satisfy both requirements, forward-thinking industrial designers planning the trains, planes, and boats of the future are turning more and more to plastics materials—first for their light weight which is so important to speed, secondly for ease of maintenance, and thirdly for the fact that they can be molded or formed in large one-piece units that facilitate assembly and result in lower costs.

Perhaps the most exciting of the plastics developments in the transportation field are cur-

Train X, a new concept in passenger transportation, uses all-plastics decor to obtain low maintenance costs and minimum weight. (Photo, Pullman Standard)

Similar requirements have boosted use of vinyls and laminates in aircraft interiors. (Photo, Lockheed; design by Henry Dreyfuss)

Potential markets for plastics also exist in such radical innovations as the monorail car (above), that skims along suspended from a single rail. Car's skin is reinforced plastics; glazing is acrylic; in interior (right) are reinforced plastics seats and acrylic light diffusers. (Photo, Monorail, Inc.)

rently taking place in the design of today's high-speed trains. According to T. C. Gray, Pullman Standard Mfg. Co., Chicago, Ill., "it seems reasonable to predict that the next ten years will see the rapidly expanded use of plastics, since two of our major design problems have become increasingly important in our new passenger car concepts—light weight and low operating and maintenance costs." A major step in this direction has already been taken by Pullman Standard in the design of Train X—a lightweight, low-silhouette, low-cost, low-maintenance train being built for the New York Central railroad. Train X features an all-plastics decor. Floors are covered with $\frac{1}{16}$-in. vinyl tile, walls are covered with melamine and vinyl facings permanently bonded to aluminum, window trim panels are molded of reinforced plastics, ceilings are covered with vinyl facings bonded to fibrous glass insulation, light diffusers are formed of acrylic, seat trim is vinyl, and decorative bulkheads are fabricated of melamine laminates. Phenolics are used extensively in the electrical system of the train and for the first time ever in a railroad passenger car, the belly section is filled with foamed isocyanate insulation.

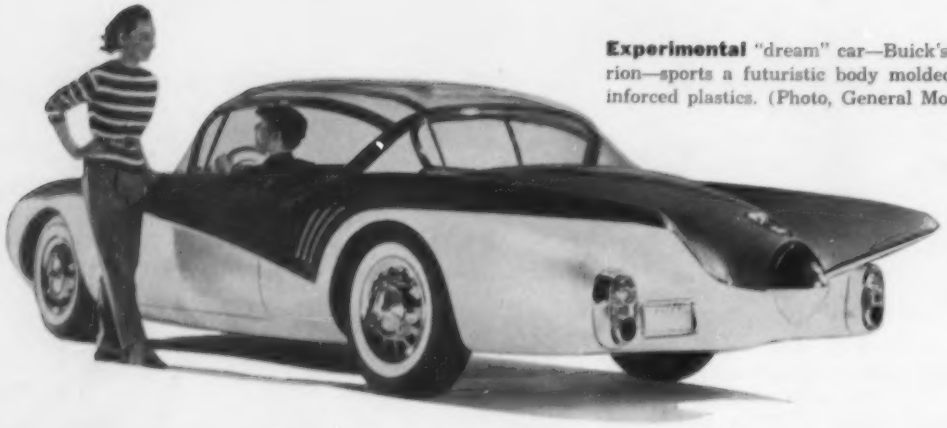
From under locked doors of (*To page* 381)

Automobiles

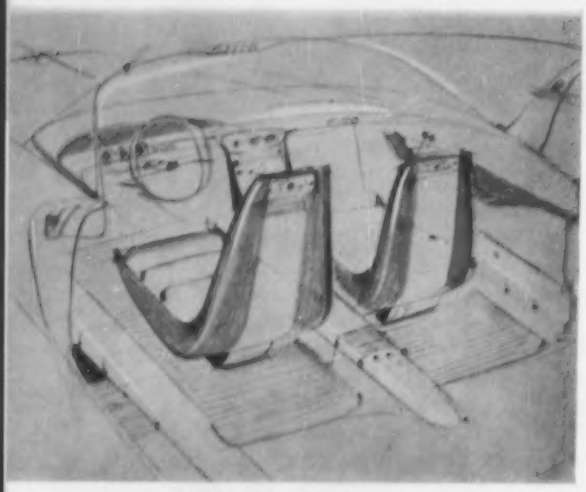
". . . a 9 million-a-year new car market by 1965, with around 70 million cars jamming the highways. There are now over 51 million passenger cars on the road."—p. 153

By the time 1960 rolls around, automotive engineers feel confident, improved plastics materials and improved processing techniques more adaptable to production automation will have boosted plastics usage by the industry from the 11-lb. average now going into the modern automobile to at least 16 to 18 lb. per car. By 1965, the figure may go even higher.

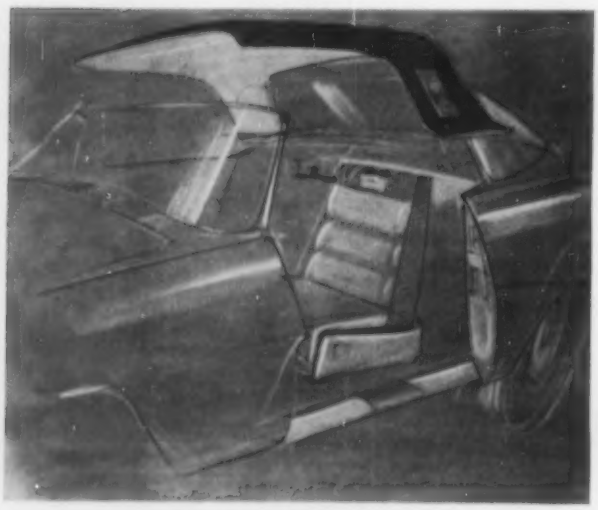
Application-wise, interior styling—already a familiar market for plastics—shows probably the greatest potential for growth within the next decade. An experimental automobile interior designed almost entirely in plastics by Pratt Institute under the sponsorship of Monsanto Chemical Co.'s aggressive Market Development Dept., vividly points up the lines along which interior plastics applications are developing. Probably the most important is in the design of the seats. The bucket, or bottom and back of the seat, is molded in one piece of reinforced plastics and upholstered with polyurethane foam cushioning. A textured vinyl is



Experimental "dream" car—Buick's Centurion—sports a futuristic body molded of reinforced plastics. (Photo, General Motors)



In interior styling for tomorrow's auto, potential applications include reinforced plastics seats, foamed plastics cushioning . . .



. . . plastics instrument panel, and roof liners (in styrene or reinforced plastics) backed up with foam. (Sketches, Monsanto and Pratt)

sprayed over the cushioning. Other improved plastics features in the model include: a one-piece formed styrene alloy door liner that slides into place on channels; a one-piece styrene head liner (which can also be made of reinforced plastics) that snaps into place inside the car roof; plastic foam between liner and roof to serve as acoustical and thermal insulation and as a safety feature; a one-piece plastic instrument panel (either in reinforced plastics, vinyl, or styrene); and a vinyl floor covering which can be sprayed or laminated.

In designing the experimental interior, the students at Pratt Institute took cognizance of the two factors that are expected to have the greatest influence on plastics' future in the automobile industry—the trend towards increased passenger safety and the growing importance of mechanization and automation on the production line.

Safety features imply a more extensive use of plastics. With the existence today of one car to every 700 ft. of highway, automobile manufacturers are looking to safe, resilient plastics applications as a means of cutting down on the rate of injuries sustained in accidents. By 1960, one manufacturer predicts, crash pads cushioned with vinyl or polyurethane foam will have graduated from optional equipment to standard equipment. Similar developments are expected in door panels, roof liners, front-seat side shields, kick panels, and pillar coverings formed of resilient styrene copolymer sheet.

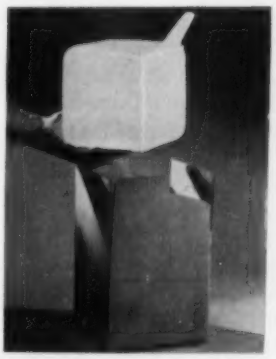
Up until now, cost has been a major deterrent to great expansion of plastics in automobile applications. But the cost curve is moving downward—and, more important, manufacturers have found that the design flexibility inherent in plastics can be used to advantage in reducing production and labor costs. In the Pratt experimental model, for example, spraying vinyl onto the cushioning eliminates the

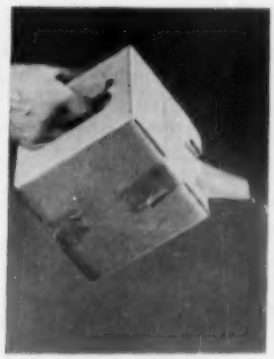
labor and time necessary for making patterns, cutting, and sewing fabrics onto auto seats. Even more advanced is the concept of spraying the vinyl into a textured female mold, pouring the foam into the mold through a nozzle, and then stripping a completed cushion from the mold. Other production savings are seen in the ease with which the snap-in plastic head liner can be assembled in place and the labor eliminated by the one-piece door liner (with integral texture and coloring) that simply slips into place along channels.

In the more immediate future, another expanded use of plastics in interior styling (especially vinyl upholstery and vinyl coverings) is foreseen in the growth of sales of station wagons. As more and more of the population moves out to the suburbs, the number of two-car families (there are now more than five million in this country) is (*To page* 385)

Packaging

". . . We have a deep conviction there's a great future for plastics in packaging. The surface hasn't even been scratched. Some of the most promising plastics materials are now barely in the same state of infancy and potential use that cellophane was in 20 years ago."—Roger Putnam, Chairman of the Board, Package Machinery Co.





Among new polyethylene containers in demand for shipping chemicals is cube-shaped unit with molded-in spout. (Photos, Bakelite)

If the present serves at all as a reliable guide to the future, many notable advances may be expected from plastics in the packaging industry within the next decade. Some of these developments may be revolutionary in nature, but most will evolve naturally from techniques, materials, and combinations of materials now in use.

One major stimulus to the growth of plastics in packaging has been the recent emphasis on self-service selling and automatic merchandising. With the tremendous advances being made in this field, coin-operated dispensers will soon be making their appearance in many new locations and offering convenient sales of various products at all hours. One retailer foresees the possibility of department stores of the future opening automatic branches, using banks of vending machines built into store fronts. To accommodate the special requirements of this new merchandising concept, transparent molded packages and transparent film packages that allow the customer to see what she is purchasing and colorful molded packages that stimulate impulse buying are "naturals."

Material-wise, much of the development work now going on in the over-all packaging industry has centered on the plastics films, alone or in combination with each other or with other materials, such as aluminum foil. Already, they are being used in lightweight, convenient, easily stored flexible packages for sliced luncheon meats and scores of other food products. When required, these packages may either be evacuated or filled with nitrogen or other inert gas to provide greatly extended shelf life.

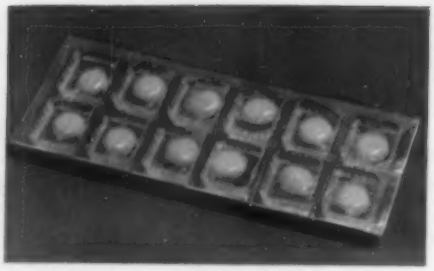
Polyethylene film, in particular, has come up very fast in the packaging field and appears destined for even greater things—not only in the food field but in the packaging of various products sold through hardware, variety, and department stores. According to the results of a survey recently conducted by the Market Development Dept. of Monsanto Chemical Co., polyethylene film will account for about 225

million lb. of the flexible packaging market in 1960. As the price of the film lowers (it is already lower in price than cellophane), as transparency and quality are improved, and as self-service selling expands, an even greater growth pattern should be seen by 1965.

Liquid and semi-liquid products sold in bags formed of plastics films or film laminations are also rapidly opening up entirely new ideas in packaging products ranging from mustard and catsup to adhesives and pharmaceutical preparations. Inherent in this concept is the design of "one-shot" packages that permit controlled dispensing of the contents. The film bags, since they can now be filled and sealed at high speeds, are especially valuable for sampling of new products.

Also of great future significance is the use of Mylar polyester film packages for the rapidly growing frozen food market. The Lüchow restaurant in New York, for example, is now packaging several of its frozen meat specialties in polyester bags. Without defrosting, the unopened bag can be dropped directly into boiling water. The bag is then removed, cut open, and the cooked contents served on a plate—hot and ready to eat.

Another company, Aquafoods Corp., Tampa, Fla., has developed a package for seafood—both fresh and frozen—based on Mylar polyester film. According to the company, the package makes it possible to display the products under normal refrigeration where they do not compete with the limited space available in frozen food bins.



Polyethylene packet for shell-less eggs may supplant present packaging methods. (Photo, Cornell)

Closely related to flexible plastics film packages are the many types of plastics liners now being used with corrugated shipping containers, metal drums, and other types of basic packages. Galva Creamery Co., Galva, Ill., has pointed to an increased future use of this application with their development of a plastic film bag (in combination with a corrugated shipping container) for shipping cream from producers to butter manufacturers. As a replacement for the 5-gal. steel cans previously used, the new containers can accommodate more material, take up less space, and are easier to clean. In addition, product purity is protected by the chemically inert polyethylene, which cannot affect cream taste or odor.

Another development in the area of plastics liners is the Cubitainer designed by Hedwin Corp., Baltimore, Md. The Cubitainer is composed of a semi-rigid polyethylene insert and an outer corrugated box and is used primarily for single-trip shipments. The tare weight of a typical Cubitainer package is 7¾ oz., as compared to 14¼ oz. for a comparable steel container and 46 oz. for a glass package. The polyethylene insert has a convenient handle and a spout which permits simple dispensing of the product.

Plastics "squeeze" bottles also appear to be heading for important new markets during the next few years. One of the most exciting developments along this line is the rapid progress being made by collapsible polyethylene tubes, which lend themselves to fast production, filling, and sealing; take printing beautifully; and bring a new concept of convenience to the packaging of adhesives and many other types of products. It is now possible to apply internal coatings to the collapsible tubes (as well as other variations in polyethylene bottles) to broaden their utility for numerous products, including such items as toothpastes, shaving creams, and other various foods.

Latest advance in film packaging—a polyethylene bag for shipping cream. Bag holder (left) facilitates filling. (Photo, Galva)

Polystyrene, vinyl, acetate, butyrate, and polyethylene, are also involved in the growth of rigid and semi-rigid packaging. Today's housewives find dozens of food products, ranging from ice cream to gelatin desserts attractively packaged in molded plastic containers—many of which are re-usable as freezer containers, serving dishes, and others.

The packaging of vegetables, fruits, etc., and of baked goods holds particular promise for molded plastic trays and baskets overwrapped with plastic film. Tomato boats, for one, have aroused considerable interest among retailers. Gilbert Plastics, Inc., Hillside, N. J., reports that its Seequal-Pak styrene trays wrapped in clear film already account for about 5% of the total packaged tomatoes sold . . . and the percentage continues to grow. Although tomatoes so packaged are priced 3¢ higher than those conventionally packaged, tests (*To page* 388)

Communications

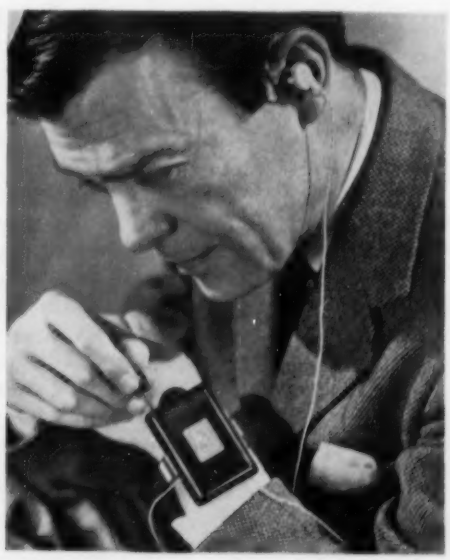
"During the past five years, when prices have been relatively stable, millions of families have climbed upward in income groups and therefore in discretionary spending power."—p. 151

Consumer purchases of radios, TV sets, phonographs, and tape recorders are expected to hit a record high within the next decade as purchasing power and standards of living continue to increase and as technological advances in electronics continue to obsolete present equipment. Looking to the future, the revolutionary product designs which are being anticipated to meet the demands of this market present opportunities for new applications that can very possibly account for the largest volume of plastics ever consumed in the field of communications.

Bearing directly on the future of plastics in the industry has been the trend towards miniaturization, which has been accelerated by the development of transistors to replace vacuum tubes, by advances in printed circuitry (involving plastics laminates), and by the design of progressively smaller microphones and speakers. Both radio and TV sets are being designed in smaller portable units—and plastics have been generally selected as the ideal material for molding compact, lightweight cabinets.

In the radio field in particular, where the impact of miniaturization has been most strongly felt, molded plastics cabinets—long a

Transistorized wrist radio (right) that makes good use of plastics components (below, styrene case halves and phenolic laminate printed circuit) symbolizes trend to miniaturization in radio and TV. (Photo, LEL)



Eventual development of portable thin-screen TV that operates on batteries may open new markets for attractive and rugged plastics cabinets. (Sketch, RCA)

standard application—have increased in number. It is significant as well that most of the more recent portable cabinets have been molded in the new high-impact "unbreakable" thermoplastics.

To electronic engineers, it is conceivable that someday two-way wrist radios which everyone can wear and which will be capable of communicating over distances of several miles can be expected to develop. Several pocket-size radio receivers already on the market point the way toward this eventuality.

One of these is a transistorized wrist radio developed by LEL, Inc., Copiague, L. I., N. Y. Measuring only 2¾ in. long by 1¾ in. wide by ¾ in. thick, and weighing only 2.5 oz. (including batteries), the radio can be worn on the wrist, where it will fit comfortably under the sleeve of a jacket, or carried in a shirt pocket. The high sensitivity of the receiver permits its use with no external antenna at distances up to 25 miles from a transmitter of average power.

Contributing to the design of the unit are three major plastics components. The lightweight rugged case is molded in two parts of Dow general-purpose styrene by The Jamison Plastic Corp., North Bellmore, L. I., N. Y.; inside the miniature case is a compact printed circuit based on $\frac{1}{32}$-in.-thick Formica XXXP-36 and supplied by Photocircuits Corp., Glen Cove, N. Y.; and attached to the "hearing aid"-type receiver is a flesh-colored acrylic holder which fits around the ear.

Another step in the same direction is a transistorized pocket radio pager developed by Motorola, Inc., for use in personnel communications. Weighing only 10 oz., the tiny electronic device is carried in the pocket. An alerting buzzer sounds when the wearer is being paged; then he hears a voice message over the diminutive receiver. The system is operated from a switchboard and has sufficient range so that key personnel are reachable no matter where they travel in or near a building or group of buildings.

Plastics components in the pager include a sleeve-like case which is molded of maroon Tenite II butyrate and a phenolic (*To page* 393)

Furniture

"Approximately $5.9 billion will be spent for furniture in 1965, as compared to the $3.5 billion spent in 1954."—"The Business Outlook for 1965"

The growing interest in plastics in the furniture industry ties in closely with broad changes taking place in our way of life. With the decline of formality in the average home and increased emphasis on active casual living, today's families want furniture that is colorful, carefree, and comfortable . . . well designed, durable, and as modern as the newest cars.

As a result, many progressive furniture designers are turning to plastics to translate these goals into actualities—particularly since many of these plastics furniture applications are adaptable to mechanized mass production techniques . . . and that means lower costs as compared with traditional processes.

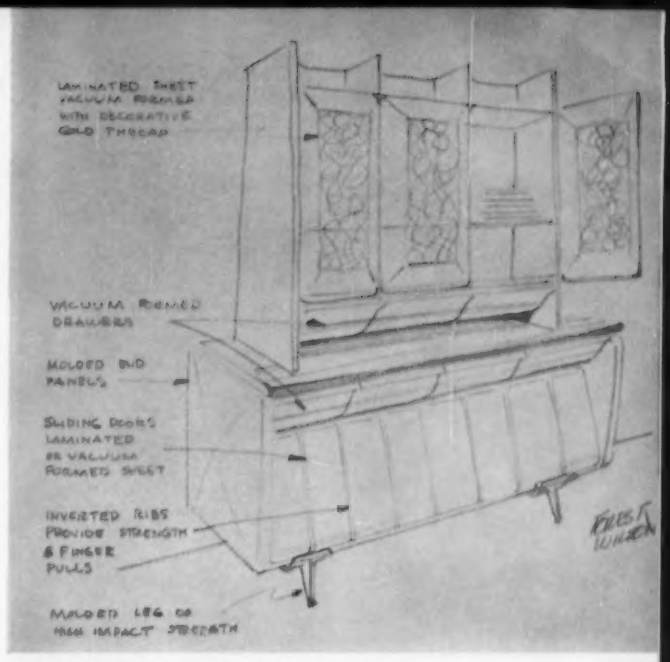
In reinforced plastics, for example, designers have found a versatile new construction medium combining light weight, high strength, inherent color, and a freedom of design treatment economically unattainable with wood or other traditional furniture materials. At least one major furniture manufacturer (Kroehler)

has already introduced a high-quality sofa with a reinforced plastics frame.

Another supplier is now producing basic chair shells of burlap-polyester laminate, using the bag molding technique. One unusual feature of the shells is that one-half of a regular metal zipper track with cloth edge is molded directly into the seat of the shell. In upholstering the chair (which is padded with vinyl foam cemented to the shell), the end manufacturer uses a decorative fabric slip cover with another half of a zipper which mates with that molded into the shell—thus insuring positive attachment to the basic structure and, at the same time, eliminating sewing or other complicated fastening methods.

This construction approach may mark an important new trend in the furniture field, since by the use of basic frames the furniture producer can spread the tooling cost over a larger number of units. At the same time, enough flexibility is provided so that styling modifications can be made to satisfy market requirements.

The one-piece plastic drawer is another furniture application that has been several years in the making but which now looks as if it is about ready to start rolling into large-volume markets. Today, at least two molders are producing one-piece phenolic drawers, a number of case goods on the market incorporate the drawers, and they are being made available to "do-it-yourselfers" who wish to have handsome, warp-proof, scratch-resistant drawers in their home-made furniture. In addition, high-impact styrene drawers molded by General Electric Co.'s Plastics Div. are now being used by Sears, Roebuck & Co. in its new line of Harmony House furniture. And drawers vacuum formed of thermoplastic sheet have started to come into the picture.



Revolutionary buffet design is based on adaptability of plastics to low-cost production and assembly. (Sketch, Forest Wilson Assoc.)

Desk tops molded of resin-impregnated granulated wood are on the growth list of plastics school furniture. (Photo, Monsanto)

Many furniture designers believe that some of the new plastics foams, such as the vinyl and polyurethane types, have an almost unlimited future potential. With them, traditional and costly upholstering operations can be eliminated by foaming the cushion in place on the shell and heat sealing decorative vinyl sheeting directly to the cushion in an integrated mechanized operation. If desired, a vinyl foam cushion can even be molded with an integral vinyl skin.

Vinyl foam cushions have already been put to good use by Herman Miller Co. in a line of sofa and chairs designed by George Nelson & Associates. Cushioning is made up of die-cut marshmallow-shaped disks of 3-in.-thick vinyl foam which are screwed into place on a basic steel frame. The cushions can be upholstered with vinyl film electronically sealed to the foam, thus providing considerable styling flexibility.

Other potential applications loom just over

Newest advance in sofa design—foamed vinyl cushions screwed into place on frame. (Photo, G. Nelson Assoc.)

the horizon. As envisioned by Forest Wilson, head of the industrial designing firm of Forest Wilson Assoc., Chicago, Ill., here are some of the future possibilities for plastics:

1) Integrally reinforced decorative melamine surfaces for tables, etc. This type of construction, intended to eliminate the need for mounting the decorative plastic surface on a supporting material—e.g. plywood—would consist of a melamine table top surface with a molded-on bottom core, such as honeycomb. The bottom surface might incorporate a grid or ribbed design to facilitate attachment to the table frame.

2) Legs for tables and other units utilizing formed plastics outer shells. In this application, legs having a shape costly or difficult to execute in wood could be blown or formed of a suitable opaque colored thermoplastic material, such as polyethylene. This unit would then serve as a mold into which a suitable type of epoxy resin-ground metal combination or other "plastic solder" would be poured. A removable core inserted in the shell would hold the volume of material needed to a minimum. Built-in fastening devices could also be inserted in the shell before the introduction of the casting material.

3) Mounting plates, etc., (*To page* 394)

Industrial

". . . As I view the longer-range picture, our country is moving steadily toward the goal of a gross national product of $550 billion by 1965 . . ."—Harlow Curtice, President, General Motors Corp.

In what has been referred to as the second industrial revolution, American production facilities are turning more and more toward automation as the key to an increased gross national product. And, according to today's electronics engineers, a good deal of the future of automation is wrapped up in the engineering of plastics materials for the job.

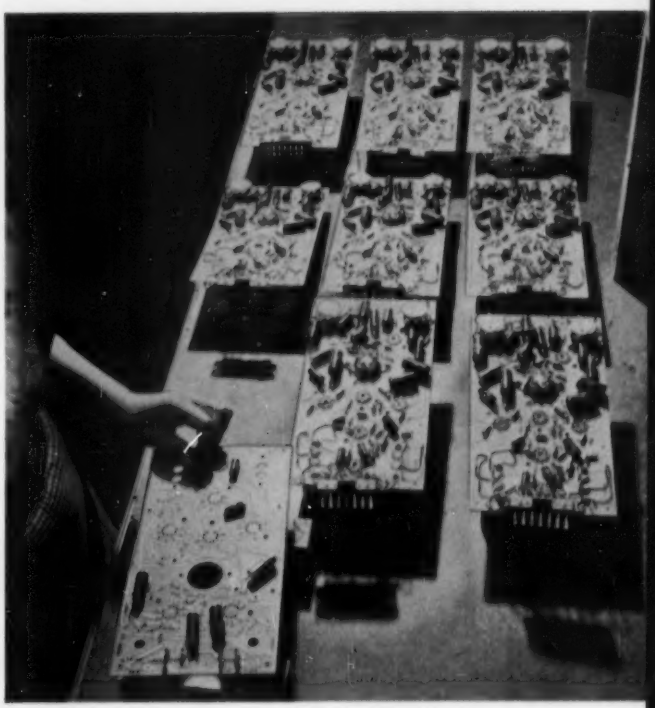
With business operations becoming more complicated, with costs on the upswing, and with our economy growing faster than our labor force, automation involving the use of machines to take over some of the control functions normally provided by human operators has become a virtual necessity to an improved standard of living. As described by Dr. E. W. Engstrom, senior executive vice-president of RCA, "an essential ingredient of the (first) industrial revolution was the removal of the limitations of power imposed by the capabilities of humans and animals. Now the limitations of humans in decision-making and control are being superseded. Electronic systems can handle information and can control mechanisms at enormously greater speeds and accuracies and, therefore, in vastly greater quantities than humans can."

Designing, engineering, and manufacturing this equipment has become a brand-new industry in our economy—and another market for plastics materials. Remington Rand, for example, whose equipment has already been put to use for such diverse purposes as figuring payrolls and checking insurance premiums data, reports that plastics have helped considerably in the development of its computing machines. Functional interior components involve nylon, styrene-acrylonitrile, phenolics, phenolic laminates, polyester film, epoxy resins for potting and encapsulation, and, most important of all, printed circuitry based on phenolic or epoxy glass laminates. On one molded application alone, a piece the size of a punch

card has been designed to accommodate 500 switches—an engineering feat virtually impossible with any other material.

On other machines for other markets—not only for computing but also for controlling the production line—plastics are playing a similar vital role.

Plastics are also involved to a large degree on the other side of the fence—designing the product so that it is adaptable to mechanized production. The development of printed circuitry, for example, has been the key factor in making it possible to use mechanization in producing such electrical and electronic products as radios, television sets, test instruments, industrial control units, and many appliances. In the radio and TV field, in particular, printed circuitry and the development of the transistor have revolutionized production. Because the printed circuit board is regular in shape and puts all of the conductors into one plane, the electronics industry is provided for the first time with a means of handling its products in automatic machinery. The use of resins for potting and encapsulation and the contribution made by molded plastics parts and thin-gage plastics films to miniaturization have also helped in the development of product design that is adaptable to mechanization or even automation in production.



First step toward concept of fully automatic production—an amplifier assembly operation that can be performed faster and easier by using printed circuits on epoxy-fibrous glass laminate bases. (Photo, Shell chemical)

Appliances

"... 60% of American homes will be air conditioned by 1965 and annual sales of refrigerators and automatic washers will have increased by 1 million units by the same year."— p. 153

Although the appliance industry is already counted among the large-volume users of plastics materials, sufficient opportunity exists for plastics applications in future product design to make the poundage consumed today, impressive though it is, pale by comparison.

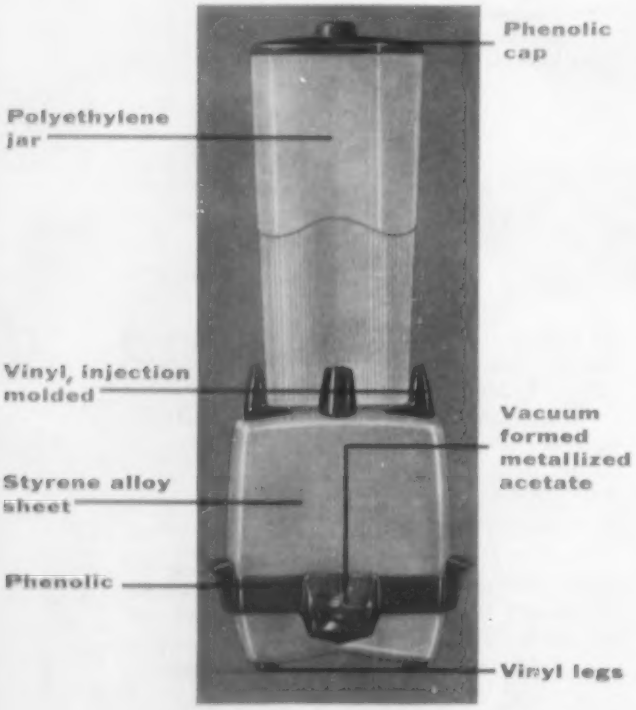
There are a number of factors that appliance manufacturers point to as basis for this conclusion:

1) The appliance industry itself is in the midst of the greatest market growth period in its history. By 1965, it is expected that sales volume will have more than doubled to a $5 billion figure.

2) Appliance manufacturers are basing a good share of their future merchandising campaigns on what one manufacturer describes as "dynamic obsolescence." In essence, this means that an effort will be made to tap the vast replacement market in staple appliances (refrigerators, for example) by a continuous program of annually improving product design and styling—in much the same way as the automobile industry brings out new and improved models every year. To accomplish this, appliance stylists are turning more and more to the use of colorful, textured plastics.

3) Technological advances are making

Washing machine with reinforced plastics tub and cover points to the future possibility of an all-plastic unit. (Photo, Apex)



Decorative and functional parts used in designer's conception of blender are adaptable to other appliances. (Sketch, G. Stahl)

available more and more different types of appliances—each one another potential market for plastics. Since the late 1930's, with the appearance of automatic dish washers, dryers, freezers, etc., the number of appliances on the market has already doubled—and the end is still nowhere in sight.

Perhaps the best illustration of the strides which plastics have been making in the appliance field can be seen in the design of the modern refrigerator. In the March 1952 Futures issue of MODERN PLASTICS, a one-piece plastic inner door liner was mentioned as "a possibility for the future." Today, only four years later, the vacuum-formed high-impact styrene door liner has virtually become standard equipment.

And the refrigerator industry has even bigger plans on tap! The concept of a one-piece door incorporating exterior shell, inner liner, and integral shelf supports is still alive and kicking. And the modern emphasis on color, coupled with the developments in adding a glossy finish to styrene sheet, has revived interest in the use of plastics for other exterior shell components.

A good deal of work in the refrigerator field has also centered on the decorative plastics materials, particularly metallized. Admiral Corp. has made one step in this direction by offering with their new model refrigerators a kit containing five squares of metallized and embossed Mylar polyester film, each different in color and backed up with pressure-sensitive adhesive. When the housewife wishes to change kitchen decor, she simply uses the appropriately colored film, pressing it into place in the area provided for it in the front of the refrigerator.

Another refrigerator manufacturer has expressed interest in printed oriented styrene sheet laminated to high-impact styrene sheet. Says this manufacturer: "Since thin-gage oriented styrene sheet is already being laminated to the face of high-impact sheet to give it the gloss required for inner door liners, why not print color areas on the oriented material so that when the liner is formed, the color will register on the appropriate raised portion?" This manufacturer already is experimenting with a two-tone door liner in which the shelf supports will be one color and the background another.

In other segments of the appliance field, some of the newer plastics processing techniques and some of the newer plastics materials are

being fitted into futuristic design. Formed plastics sheeting, for example, is expected to play an increasingly important role. In line with "dynamic obsolescence," manufacturers can use a basic die-cast metal frame or housing and make liberal use of plastic inserts—which can be formed on quickly made and inexpensive tools—to change the styling of the appliance annually. Appliance housings formed entirely of glossy high-impact styrene sheet or textured styrene copolymer sheet are also under consideration. One company in the Midwest will be out with a formed styrene copolymer air conditioner housing this year; already on the market is a fan formed of styrene copolymer sheet.

Material-wise, the polyester-glass laminates are figuring prominently in the future plans of several appliance manufacturers. Air-conditioner housings are already in the (*To page* 397)

Housewares

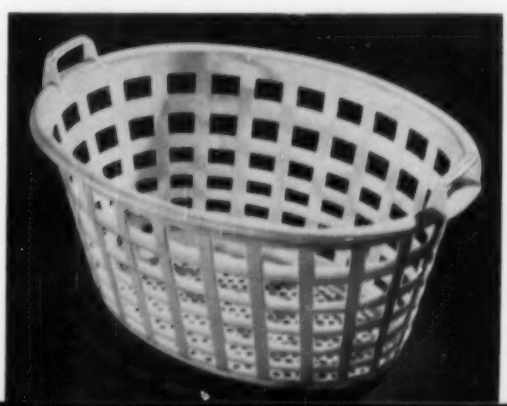
". . . the market for plastics housewares has grown 65% during the past three years . . . most of this growth came last year when retail sales shot up 30 percent . . . the 1955 total of plastics (styrene and polyethylene) used for housewares was estimated at 104 million pounds . . ."—Plastics Housewares Survey prepared by Market Development Dept., Monsanto Chemical Co.

The housewares industry is too stable and conservative to make long-range predictions as to innovations involving plastics materials that may come along within the next decade. And it doesn't seem likely that there will be any radical changes in the already-proved functional design of such standard items as dishware, salt-and-pepper shakers, bread boxes, canister sets, tumblers, trays, etc.

What can be predicted for plastics in the housewares industry, however, are increased volume sales based on the growth of the overall housewares market, the anticipated increase in disposable personal income, the sales stimulation afforded by the consumer-appealing advantages of the newer plastics materials, e.g. polyethylene, styrene alloys, etc., and by the cost savings made possible by improved techniques in vacuum forming, high-speed injection molding, etc.

According to Monsanto's market survey re-

Future markets for plastics in the housewares field look especially bright for large polyethylene moldings, such as baby baths . . .



. . . and laundry baskets, that simplify and lighten the everyday chores of homemakers. (Photos: top right, Bakelite; right, Monsanto)

port, sales of plastics housewares from 1952 through today have increased at a rate of seven times that at which personal disposable income (see Chart 2, p. 151) has increased. Annual housewares sales now total $4 per household.

In a more specific breakdown, Monsanto estimated that in 1957 some 42 million lb. of styrene and 38 million lb. of polyethylene will be used for general housewares (canister sets, bread boxes, cutlery trays, etc.), and approximately 32 million lb. of polyethylene will be used for large moldings (wastebaskets, basins, pails, etc.).

It is in the latter area, where polyethylene competes effectively with metal (*To page* 398)

Disposable cups in snack bars and coffee vending machines may presage full line of disposable tableware. (Photo, Monsanto)

Leisure Markets

"It is conservatively estimated, for example, that 30,000 swimming pools will be built in 1956 . . ."—p. 153

A major manifestation of the interest which the American public is today centering on leisure-time activities has been the recent phenomenal growth of backyard swimming pools. One leading economist has already predicted that, by 1965, the family swimming pool will be as common as the family garage. But at the rate swimming pools are selling today, that situation may be realized in far less time. Of the 56,000 pools of all types in the United States today almost one-third were sold in 1955—the year the pool construction boom took hold.

Sharing credit for this fantastic upsurge in pool sales have been, on the one hand, the expansion of outdoor living brought on by the mass exodus to the suburbs and, on the other hand, the adaptability of plastics (especially reinforced plastics and vinyl sheeting) to mass-produced pools within the reach of families in the $8500 to $10,000 income bracket. According to Robert M. Hoffman, publisher of *Swimming Pool Age*, if sales of plastics pools continue at their present rate, "by 1960, some 250,000 pools will be in use, of which over 100,000 will be based on vinyl sheeting or reinforced plastics."

Whether in reinforced plastics or in vinyl, the backyard pool is well within the means of the middle-income family group. A typical permanent reinforced plastics swimming pool, as marketed by Delorich, Inc., North Miami, Fla., for example, could be installed with filter for $2500 to $3000, depending upon location. The 15- by 30-ft. pool is made up of molded sections, available in color. As production techniques are refined and as sales increase, prices should come down even further.

Vinyl sheeting is used in inflatable temporary pools that range in size up to 25 ft. in diameter, and as linings for permanent swimming pools. A complete kit, incorporating the flexible vinyl liner, for building a 12- by 27-ft. pool is available from Sears, Roebuck & Co. for $899.

The swimming pool market is also developing an outlet for plastic piping (primarily polyethylene), pointing to the all-plastic pool—completely water- and corrosion-resistant, long lasting, and easy to maintain.

Plastics engineering in THE YEARS AHEAD

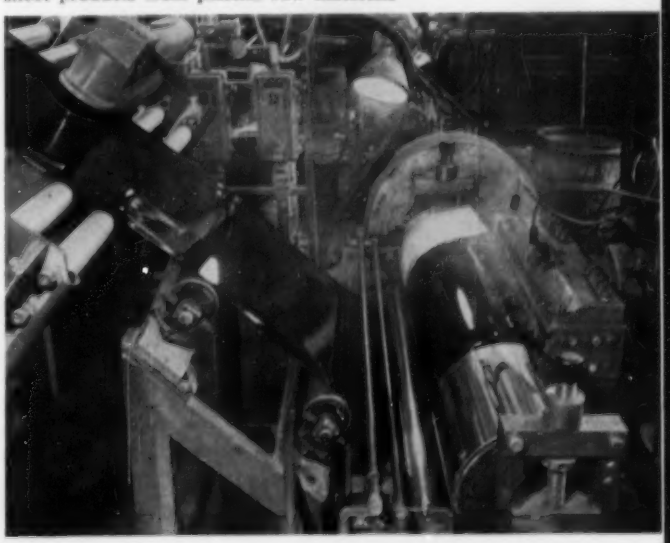
Greater productivity, better and more uniform quality, and lower unit costs are coming in the important branches of plastics processing, in spite of higher labor costs. These objectives will be achieved by application of sound engineering ideas to machine design and process operation, by extension of automation both horizontally and vertically, and by new invention.

The most promising trend in plastics engineering today is the growth of interest in the reasons why processing operations behave as they do, in the underlying mechanisms of fluid and solids behavior, heat transfer, and chemical reaction, and in measurements concentrated on the state of the material being processed rather than on the machine. From such fundamental studies, begun about a decade ago, have come and will come big rises in machine productivity and product quality. Not many years ago a processor could make money if his equipment turned out a salable product at almost any production rate, and products were not hard to sell. Today the competition has sharpened to the point where an operator must achieve moderate-to-high productivity just to stay in business. In the coming years this competition is going to grow keener.

The chemical processors have been fortunate in that many of their unit operations could be effectively studied on a very small scale. Even the financially pressed engineering schools could afford equipment to undertake many of these studies, and a great deal of the progress in chemical and mechanical engineering methods can be traced to the published work of university staffs and graduate students. To a fair degree the schools have also contributed to fundamental knowledge in the fields of polymerization and behavior of polymers in dilute solutions.

Polymer processing research, however, is much more expensive. Even the smallest injection molding machine costs in the thousands of dollars; so does a 2-in extruder, and it is dubious whether any far-reaching results can be had with an extruder of smaller size. In addition, it takes a lot of material to run one of these machines. The material, unlike the simpler chemicals, is not easy to recover and reuse; most polymers change a little with each pass through processing equipment and these

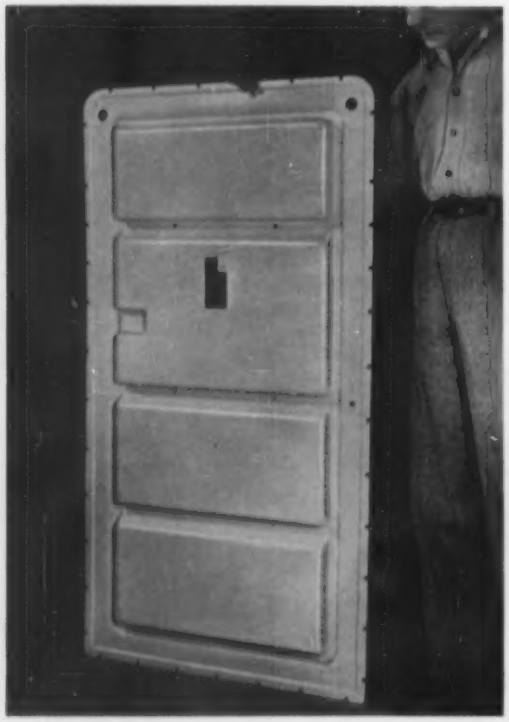
Modern set-up for extruding heavy thermoplastic sheet. Some extruders have already been linked to forming machines. Future goal is completely automatic production of formed-sheet products from plastics raw materials



changes confuse interpretation of the experimental results. Except for work in testing materials, it is not likely that a significant amount of polymer processing research will be done by men in college.

Even the materials suppliers were slow in taking up fundamental work on processing. However, many of them have come to realize that, since the work is expensive, much of the work won't be done at all unless they do it. They know that by helping to make operations more productive they will be expanding their materials markets. Some contributions are being made by processors, but these are fewer than they should be, for two reasons: 1) processors are reluctant to share knowledge when keeping it to themselves gives them a productivity differential; 2) processors find it is painful to devote manpower, machinery, and material to research because the results of research are very often uncertain and because material and machinery account for their chief cost elements.

Large-size freezer panel formed from polystyrene sheet. Sheet-forming processes soon will wholly displace injection molding techniques in the production of a variety of large objects with uniform thin sections



The big expansion in plastics engineering is dramatically pointed up by the rapid increase in membership of the S.P.I. and S.P.E. over the past few years and by the changing character of the subject matter of their annual conventions. These conventions, which used to be regarded by engineers more as social than as technical events, this year drew record crowds and offered more fundamental engineering material than ever before. The advances of the past five years are indicative of what is to come. We can confidently expect that the membership, the volume of material produced, and the emphasis on technical matters in both these societies will increase.

Who is going to carry on all the new technical work that is so obviously needed? Most of the load will be assumed by chemical and mechanical engineers, but there is an increasing need for men specifically trained in plastics engineering. Only a few schools are presently offering full programs in plastics engineering. Within the next ten years there should be many more, most of them at the undergraduate level, where the need is greatest.

Automation

By automation in plastics processing is meant any change in the operation by which a task formerly requiring the labor or attention of a person is done mechanically or electronically. Total automation of plastics processing plants, even if it were thought practical, is still far out of our reach. But more and more elements of plant operation are being taken over by machines. It is certain that there will be more changes in this direction in the next few years, for several reasons: 1) the available labor force must become more productive if our living standards are to be maintained (see p. 153); 2) in general, machines can do repetitive jobs more accurately and consistently than human operators, and the machines do not get bored; 3) machines can do these jobs more economically.

Thermoplastic sheet forming

A few years ago, vacuum forming was hardly known, but in 1955, as our January 1956 machinery survey showed, 307 vacuum forming machines were delivered to customers. Already the term vacuum forming is almost misleading because gravity, air pressure, and plugs are all becoming important forces in thermoplastic sheet forming. "Plug-assist" forming makes it possible to mold sections with depth of draw

Table I: Percentages of injection machines of various sizes sold and total sales[a] for years 1947-55

Year	Total[a] sold	Machine rating, oz.					
		2 or less, %	>2 to 6, %	>6 to 10, %	>10 to 16, %	>16 to 28, %	>28, %
1947	285	26	17	12	36	8	1
1948	409	44	18	10	20	5	3
1949	710	55	7	14	16	1	5
1950	802	23	14	19	29	4	11
1951	517	36	19	20	19	1	6
1952	764	30	33	15	14	4	5
1953	1289	18	26	19	21	3	5
1954	977	31	27	12	21	4	5
1955	1052	24	33	9	23	6	4

[a]These totals are the totals sold of machines whose size classifications were indicated by those making the reports. About 50 machines are reported with no indication of their sizes.

and uniformity of polymer distribution which cannot even be approached by straight vacuum forming. Only recently there has been a shift from injection molding to sheet forming in the production of many shallow, dished shapes. In the same period, injection molding of deep containers—waste baskets, dishpans, etc.—has become important. It is probable that sheet forming will soon be used to make some of these items, too. The new "trapped-sheet" forming process, so successful with oriented polystyrene sheet (see MODERN PLASTICS *33*, 117, March 1956), offers a promise of high-precision shape control for many smaller-size formed-sheet products.

Another reason why very rapid developments can be expected in the sheet-forming processes is this: sheet forming has come at a time when the use of engineering principles in plastics processing has already been recognized as proper and worthwhile. The technology of sheet forming does not have to fight a tradition of bad habits, committed investment, and intuitive, unrecorded "know how," as do the technologies of the older plastics processing methods.

Automation is already having its impact on sheet forming. Some equipment suppliers are preparing to offer their customers complete packages including the sheet extruder, chilling take-off gear, sheet cutter and stacker, and sheet forming machine. The feedback-control loop involving the beta-ray gage, so successful in calendering, will soon be finding its place in extrusion of sheeting. Packaging experts visualize for the near future an extruder-former unit of the type just described intersecting a consumer product line at the packaging machine. The product line supplies finished articles to the machine while the sheet-forming equipment supplies packages ready to use and the packaging machine puts the final seal on the filled package.

Injection molding

Table 1, above, summarizes the MODERN PLASTICS January reports, since 1947, on annual sales of injection machines. For each year the total number of machines sold is listed and for each rating the *percentage* of that year's sale in that class is given. These percentages are interesting, while the total figures indicate that injection machine sales will be vigorous for some years to come. In the earlier years, a large percentage of total sales was in the 2-oz.-and-under class, reflecting the greater ease of adapting automatic controls to the making of small pieces. Very small percentages of total sales each year were in the 20-to-28-oz. class and the 30-oz.-and-up class. (Percentages of total sales dollars in these classes would, of course, be much higher.) In the class of very large machines, sales have been sliding off a little since they reached their peak in 1950. This reflects, we believe, the diminishing utility of the very large machines. These big ones, many of them equipped with preplasticators,[1] were originally bought to make large-area moldings like refrigerator door liners, battery cases, radio cabinets, waste baskets, etc. Only occasionally can they be used to make heavy pieces with thick sections, since thick sections take too long to cool. The large-area business is to an ever-increasing degree being drawn off by the sheet-forming processes. It can be expected that even

[1]This term is used in place of the conventional "preplasticizers" to gain precision. The verb plasticize means to soften by adding a low-molecular-weight liquid. Plasticate means to soften by heating, either through direct transfer of heat or by viscous working. Thus "preplasticators."

fewer of the very large injection machines will be sold in the future.

During the last four years there have been more machines sold in the > 2-to-6-oz. group than in the 2-oz.-and-under group, even though the smaller machines are cheaper. This is due to two gradually changing factors: 1) improvements in automation have made it practical to mold bigger pieces in fully automatic machines; 2) sharpened competition has begun to eliminate the operator who bought one small machine on mortgage and set up in business. Unless such an operator has a patented gimmick of his own to mold, he finds it pretty tough going, even with all the technical help and material credit he can get from material suppliers. Note also that the percentages in the > 10-to-16-oz. class have remained fairly constant throughout the years (two of which were war years).

More machines will be equipped with preplasticators in the future. Originally introduced to increase machine capacity, preplasticators are now finding acceptance for an entirely different reason, which also reflects the pressure of keener competition: machines with preplasticators operating at shots of about the *nominal rating without the preplasticators* are producing pieces of better quality, higher density, and much greater uniformity on faster cycles. This shift in justification for the use of preplasticators is a natural outcome of the work done in recent years on the theory of pressure drops in injection cylinders. This work has shown that a large part of the total ram pressure is dissipated in friction in the solid particles in the rear of the cylinder. It showed also that movement of solids in the narrow annulus between torpedo and wall is irregular, resulting in irregular pressures at the mold cavities, and irregularities in shot dimensions. With a preplasticator, the ram works directly against the melt and pressure is transmitted much more fully and dependably. The greater heating area also permits lower heating temperatures, thus reducing the risk of degrading the plastic.

A parallel development is the recent interest shown by material suppliers in the shape and regularity of their molding powders—small rounded particles with closely controlled dimensions flow more smoothly in the packing zones of injection cylinders and extruder screws than irregularly-cut particles.

Similar thoughts have inspired the development of recent torpedo and cylinder designs (see "Polyliner Improves Injection Molding," MODERN PLASTICS 33, 109, February 1956).

These efforts have all helped to increase the reliability and productivity of injection machines, but the preplasticator in its new role offers the greatest promise of them all. A preplasticator so used can, even on relatively thick-section moldings, pay for itself in less than a year.

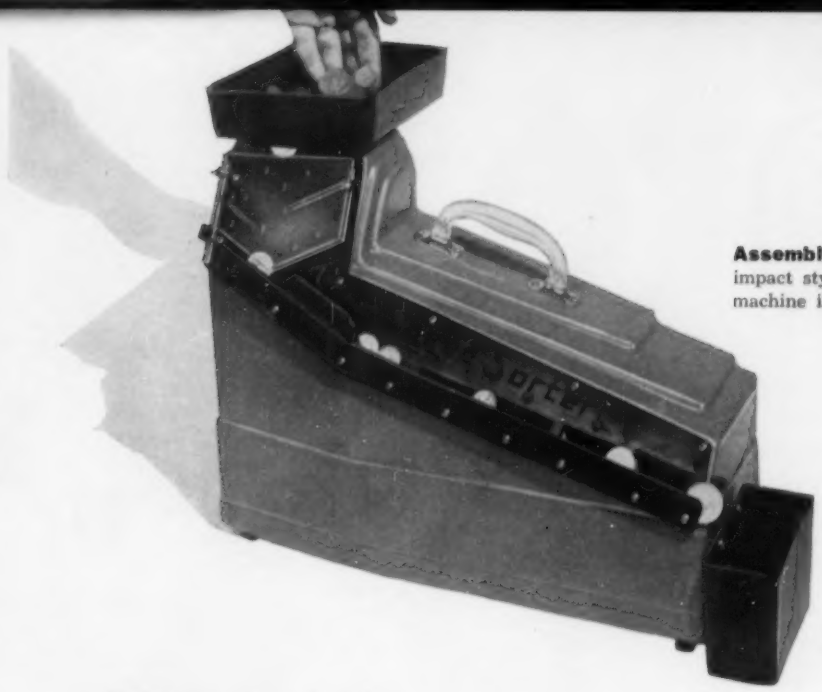
Battery of automatic transfer molding machines making tiny electrical parts practically runs itself for weeks. Similar automation for larger pieces is coming soon

Preheating injection molding feed

In the effort to increase machine capacity, so-called hopper dryers have come into the picture. Installed to dry the feed and prevent such troubles as foaming, splay, and bubbles, they usually operate by heating the feed. This reduces the heating load on the cylinder. There is no reason why injection machine feeds could not be preheated to within a few degrees of the temperature at which the material gets tacky. In this sense the hopper dryer can be viewed as a semi-preplasticator, and it will to some degree serve the functions of a preplasticator.

Refrigeration of molds

In molding thick sections, the cycle-controlling element is often the cooling time—the time needed for the piece to harden so that it can safely be removed from the mold. With preplasticators becoming more common, more uniformly fluid melts and higher pressures at the gates make possible faster filling, so colder molds can be used. Mold refrigeration may soon become popular for those jobs (*To page* 403)



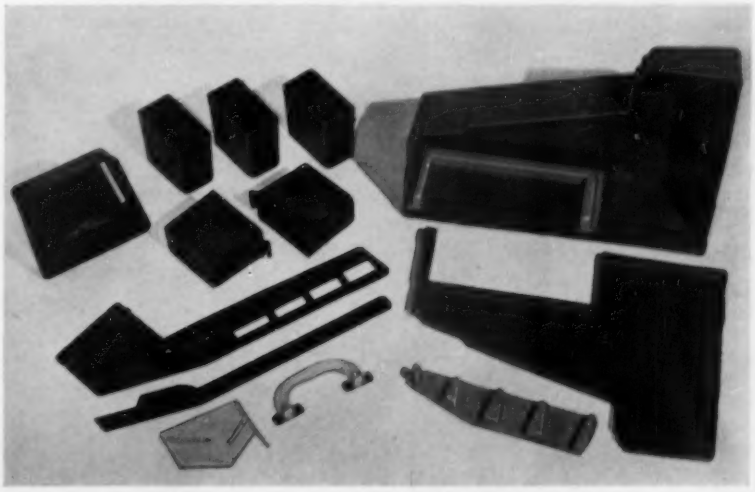
Assembled of molded butyrate and formed impact styrene parts, automatic coin sorting machine is rugged, operates fast and quietly

Portable coin sorter

has combination of vacuum formed and injection molded parts for flexibility in production control

Dividing hundreds of pennies, nickels, dimes, quarters, and half-dollars into their respective groups for counting and ease of handling can be a tedious and time-consuming chore for churches, theatres, banks, news stands, vending-machine operators, and other organizations and individuals whose operations involve large amounts of "hard" cash. Intricate and expensive coin sorters have long been on the market, but with the introduction of the ingenious new "Speed Sorter," a portable all-plastic device becomes available to those potential users who need a low-cost means of sorting coins. The speed sorter is produced and sold by the J. B. Carroll Co., Chicago, Ill.

Aside from its ingenious design and foolproof non-mechanical and non-electrical operation, the Speed Sorter is of interest because



Molded butyrate parts (at left in photo) include coin hopper, coin boxes, sorting slide, safety plate, and handle. Formed impact styrene parts (at right) include front and rear housing sections, U-shaped coin box retainer, and grooved coin chute

Following forming operation, housing part is edge-trimmed with a circular saw mounted on a router

Front housing section is removed from press. At right of machine is wheel-mounted oven that heats sheet before forming

of its well chosen combination of injection molded and formed sheet plastics parts. Involved in the construction of the device, which weighs only 4 lb. and measures 18¾ in. long, 15½ in. high, and 6 in. wide, are four vacuum formed sheet plastics components and ten injection molded parts, including a stock luggage-style handle. All of the molded parts are of cellulose acetate butyrate; the sheet stock in the formed parts is extruded impact styrene.

With the exception of assembly screws, the mounting plates for the hinged handle, and a small metal retainer for the safety plate on the front of the selector slide, the Speed Sorter is composed 100% of plastics. Among the principal reasons for constructing the unit of plastics were the following:

1) Light weight and convenient portability, so that the sorter can be easily carried even when full of change; 2) relatively low tooling cost and ease of assembly; 3) durability under a wide range of service conditions; 4) design flexibility and freedom from surface finishing problems; 5) desirable acoustical characteristics. In contrast to the jangling cacophony of a metal coin-sorting machine, the Speed Sorter muffles the sound of the tumbling coins, thanks to the inherent sound deadening properties of the thermoplastic materials used throughout.

How it works

In operation, coins are placed in the hopper and then fed manually to a selector slide where they move down by gravity, striking internal baffles which feed them singly onto the inclined sorting slide. This slide, so designed that the coins lean slightly inward as they roll down the groove, is molded with a series of four slots, ranging from the dime-sized opening at the left to the quarter-sized slot at the right end. Due to the progressively increasing height of the slots, the rolling coins automatically tumble into the correct opening as they reach it. From here they fall into four identical trays which can be removed through an opening in the back of the unit. Half-dollars, which are too large to enter any of the openings, traverse the full length of the sorting slide and drop into a fifth receptacle which is hung at the end of the sorter.

The distribution of vacuum formed and injection molded parts in the Speed Sorter, which at $55 is far more economical than complicated power-type machines, was based on careful evaluation of such factors as die costs, functional considerations, and production requirements. For example, in view of the relatively limited production of the sorter at the present time, it was considered desirable to avoid the heavy tooling investment which would have been involved in injection molding the two sections of the outer housing or case. Although large in size and weighing a total of slightly over 2 lb., these parts are economically produced by the vacuum forming process with a very modest tool investment, utilizing cast aluminum dies.

These two major parts are so designed that

the flanged outer edge of the back section fits inside the edge of the front part, permitting them to be easily and rigidly assembled by means of Phillips-head self-tapping screws. Screw heads are countersunk for a smooth, finished appearance.

Integral color

The sheet stock used in forming these two parts has an integral neutral gray color and is 3/16 in. thick, providing ample rigidity in the assembled housing. Single-cavity dies are used in forming both parts; vacuum draws the preheated sheet stock into the lower chamber, where it cools in contact with the metal punches. The two smaller formed sheet components, which utilize similar stock in 0.040-in. thickness, include a U-shaped retainer which is cemented in the bottom of the sorter to provide a locating stop for the four coin trays, and another part with tapered chutes to direct the coins into the trays as they fall through the slots in the sorting slide. This component is mounted in position by means of four screws. Unlike the large case components, the two smaller parts, also produced in single cavity dies, are made by a straight vacuum forming process.

Production of the vacuum formed parts is handled by J. B. Carroll Co. on its own press, which was designed by Carmen La Monte, manager of the company's vacuum forming division. Postmolding operations on the front housing section include edge-trimming and the drilling of 39 assembly holes. The slot in the front of the housing is stamped out with a punch press. The back of the case has 14 assembly holes which have been drilled around the outer edge.

All of the butyrate parts are produced for Carroll by a custom molding firm. Except for the transparent stock handle and the safety plate, which is molded of clear transparent material so that coins are visible as they drop through the selector slide, all of the molded parts are black. The heavy-duty tray-type containers, measuring 3 7/8 in. high by 4 3/4 in. long and 2 7/16 in. wide at the top, are produced in a single-cavity die, run on a 12-oz. injection machine. These parts, having a maximum wall section of approximately 1/8 in., are center-gated at the bottom. Similarly gated is the sturdy coin hopper, also made in a single-cavity die on a 12-oz. injection machine. This 8-oz. part is designed with rounded corners and smoothly flowing contours so that coins will move unhampered to the selector slide without becoming jammed. Three self-tapping screws, passing through cored holes in the base of the hopper, secure it in place.

Three injection molded parts

The functional heart of the Speed Sorter is comprised of an assembly of three injection molded parts—the selector slide and the sorting slide, made of black butyrate, and the transparent safety plate. For these parts, the design requirements called for a high degree of dimensional accuracy, varying wall sections, and the inclusion of the four coin selector openings. All of these were readily obtained by injection molding. The safety plate is molded in a single-cavity die on an 8-oz. injection machine; the two slide parts, which are produced on a 22-oz. injection molding machine, are from a two-cavity mold.

The sorting slide groove in which the coins roll is produced by combining the two black plastic components in the assembly process; self-tapping screws, in turn, (*To page* 410)

Molded and formed parts are assembled into coin sorters by means of self-tapping screws. Only tools required are electric drill and ratchet-type screwdrivers

Colorful battery case is molded of styrene. Removable panel in cover permits stamping coded information directly on connectors

Styrene cases for better batteries

Injection molded cases are winning an increasingly important part of the huge replacement market for automobile batteries

Currently demanding 23 to 24 million units per year, the replacement market for automobile batteries offers a rich outlet for colorful, strong, lightweight, efficiently produced battery cases injection molded of modified styrene. These four advantages of plastic cases may be summarized as follows:

1) Their broad range of attractive integral colors enables the manufacturer to offer a battery or related line of batteries having outstanding appearance and distinctive colors for immediate company identification. Such batteries lend themselves ideally to hard-hitting retail displays and colorful advertising.

2) The strength of the modified styrene material permits the case to be designed with thinner walls without sacrificing strength. As a result, the case has a larger internal capacity than a conventional hard rubber case with the same exterior dimensions. This results in an improved acid-lead ratio and increased performance from the finished battery.

3) The lighter weight of the molded plastic battery case can make possible important shipping economies. A typical styrene auto battery container weighs about 2¾ lb., as against 7 lb. for a conventional hard rubber case of the same size.

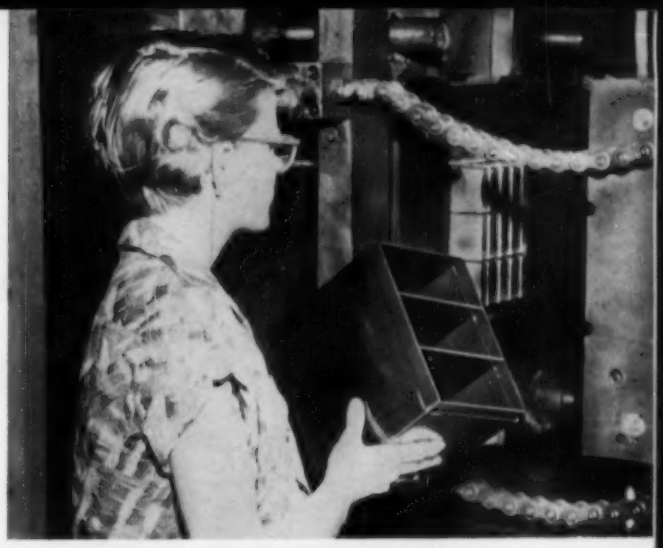
4) The speed of the injection molding process enables a battery supplier to turn out a relatively large number of batteries without the expense of multi-cavity tooling. This advantage may be offset, to some extent, by the increased cost of the plastic molding material as compared to hard rubber and other compounds used in compression-molded battery cases.

Perfected formulations

Plastics materials manufacturers in recent years have done extensive development work to perfect modified styrenes to meet the exacting requirements of this application. Any molding material used for auto battery cases must, first of all, be able to withstand the mechanical abuse encountered in normal shipment, handling, and vehicle operation. The finished case must maintain its shape and dimensions, even when exposed to the high heats encountered beneath the hood of a motor car. Finally, the material used in the case must remain unaffected by sulfuric acid and must be relatively low in cost.

From the molder's standpoint, automotive battery containers are classed as deep-draw, multi-cell parts, requiring very close attention

to such factors as mold design and balanced gate resistance. Controlled weigh-feeding of the molding material into the plasticizing chamber is often employed as a further assurance of quality and uniformity. The draft of the punch can be held to the very low figure of approximately 0.002 in./inch. Interchangeable die inserts will permit the use of the same basic set of tools for various private brand battery cases. Some minor annealing after molding will relieve internal strains; this factor, however, is not nearly so critical in auto battery containers as in the much heavier-walled battery jars for jet aircraft, which are molded of the same type of material.



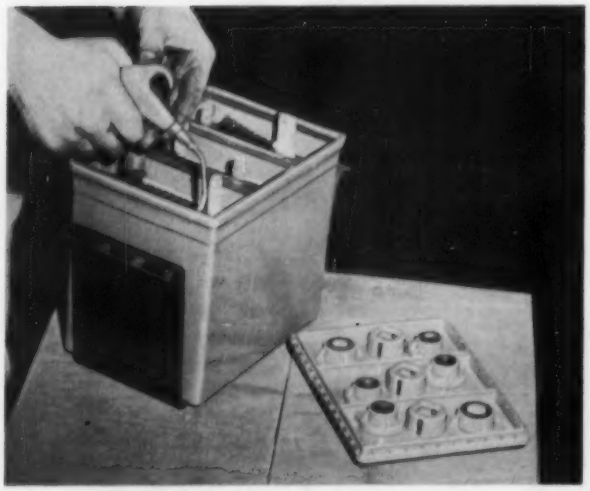
Case being removed from press is triple-gated on bottom to insure fill-out. (Photo, General American Transportation Corp.)

Strongest, lightest

One manufacturer describes its new styrene monobloc container as "the strongest, lightest, toughest, container built," and continues: "it has glamor—the one quality depended upon more than any other to move today's merchandise."

Another battery is being produced with a bright red molded styrene container and matching cover. The excellent sales acceptance of these batteries has been attributed not only to the bright red case with its relief-molded letters having an applied white color, but also to the fact that the plastic case makes it possible to build superior performance features into the battery. Promotional material states that this battery is the strongest, longest guaranteed battery of its kind, yet costs up to $15 less than any other brand that even comes close to its performance. (The battery retails at approximately $15.) The plastic case, it is declared, is "similar in design and construction to the battery containers used in newest U. S. jet fighters—actually 3½ times stronger than ordinary 'black box' batteries."

The walls of these plastic battery cases are approximately half as thick as those used on conventional hard rubber con- (*To page* 414)



Filled solvent-type adhesive is deposited in gutters fitted in top section of case preparatory to bonding of molded cover to case

Cover, placed on top of case, is held in position by metal frame and clamps until joint where case and cover meet is hardened

GREAT BRITAIN: new power + new materials

*By V. E. Yarsley**

While it has been accepted in Britain as in America that plastics are an integral part of the chemical industry as a whole, the approach to the new materials has differed fundamentally in the two countries.

The conservative British end-user industries, with the possible exception of electrical goods manufacturers, were slow and cautious in accepting plastics, while American manufacturers gave them ready trial since they offered new ways out of old difficulties. Wartime applications served to break down the traditional British approach to anything intrinsically new, but this progress received a setback right after the war by failures of products and by misapplications.

That there has been a notable change in the attitude towards plastics of both British industry and the British public during the recent past can be recorded as progress of the first order.

Second industrial revolution

Significant in the present and future development of Britain's plastics industry is the "second industrial revolution." In the 1750's a new source of power, coal, and a new construction material, iron, were the bases of the first industrial revolution. Now, 200 years later, the combination of a new source of power based on atomic fission, with new materials, plastics, is of particular significance for Britain. Statistics recently published show that progressively as atomic energy is used as a power source for Britain, so will the drain on our major natural raw material, coal, be reduced. Dr. Bronowski[1] recently estimated that by 1985 only the lower grades of coal will be used for fuel; the bulk of this valuable heritage which we have so long used profligately will be devoted to the production of chemical raw materials destined in turn for the production of plastics. The practical side of this argument has been supplied by data published by Sir John Cockcroft,[2] among others, that atomic "ash," of which growing quantities are becoming available in Britain, can be used for the direct conversion of chemicals into plastics, as, for example, the polymerization of ethylene,

*Dr. V. E. Yarsley (Research Laboratories) Ltd., Chessington, Surrey, Eng.

[1]J. Bronowski, The Seventh W. M. Thornton Lecture, The Association of Mining, Electrical, and Mechanical Engineers; York, October 28, 1955.

[2]Sir John Cockcroft, Annual Conference, British Institute of Radiology, December 1955.

Presented here are the fourth and fifth articles in the series "Wide World of Plastics" which started in our May issue.

These authoritative articles are written by plastics publication editors or industry leaders. The purpose of the series is to show the progress of plastics throughout the world.

In each succeeding issue, two or three countries will be represented.

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- Belgium
- Brazil
- Canada
- Denmark
- France ✓
- Germany (West)
- Great Britain ✓
- Holland
- India
- Israel ✓
- Italy
- Japan ✓
- Mexico
- New Zealand
- Norway
- South Africa
- Spain
- Sweden
- Turkey

✓ Covered in this issue

✓ Covered in May issue

at an over-all energy cost of the order of 1 d./lb. of plastics material produced.

If for no other reasons, 1955 could be significant in the history of British industry in that it brought the wide-spread realization of this significant alliance—new power with new materials.

Closer integration

Another factor affecting the British plastics industry is the leavening of British with American industry. This has more than compensated for the difficulties of import quotas and tariff barriers and the way ahead appears much clearer for the closer integration of the chemical industries in America, Britain, and, indeed, Europe as a whole.

Significant progress has been made during the past year in the matter of industry statistics, and the more enlightened approach of both the official trade organization and government departments to the whole question of the collection and publication of statistics will be of material assistance not only to plastics but to industry generally. Within a few hours of the publication of the annual production survey by the British Plastics Federation, it was given as an item in the main B.B.C. news broadcast. A few days previously a 32-page survey of plastics had been carried by the *Financial Times*, a significant honor hitherto reserved only for major industries in Britain or countries abroad treated as a whole.

Statistics just published by the British Plastics Federation indicate that 1955 was a record year for British plastics, both in production and export. At 640,000,000 lb., the 1955 figure showed an increase of 92,000,000 lb. over 1954, and more than doubled the 310,000,000 lb. of 1950. The current rate of expansion is stated to be slowing somewhat but, in spite of this, a total of 1,400,000,000 lb./annum has been forecast by 1965. Yet a further record was set in 1955, when for the first time in Britain the production of thermoplastics at 340,000,000 lb. exceeded that of thermosets, and contrasted sharply with 1950 when the ratio was 2:1 in favor of thermosets.

In the thermoplastic family, emphasis remains on the big three: polyvinyl chloride, polyethylene, and polystyrene—the former unobtrusively holding its own, but with polyethylene in one or another of its remarkable aliases constantly stealing the spotlight of publicity. PVC production, which is in the hands of three producers, has increased at the rate of

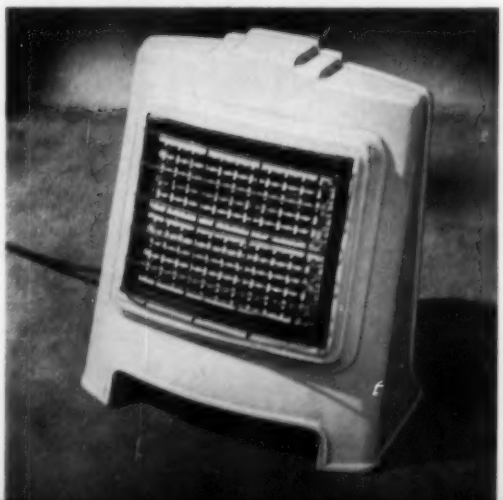
Vinyl-coated 36-in. metal impeller blades are typical of British use of vinyl chloride for "cladding." (Photo, Turner & Brown Ltd.)

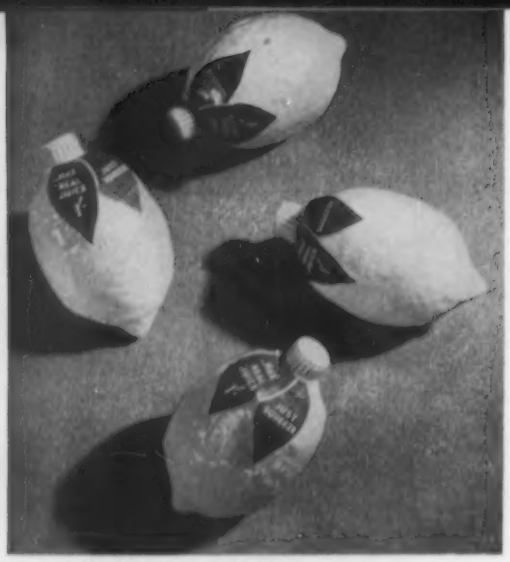
20,000,000 lb./annum over the past two years, and at 100,000,000 lb. (equivalent to 150,000,000 lb. compounded for use), it constitutes the largest single plastics group. This is expected to be doubled by 1958.

A breakdown of the current application of vinyl plastics in Britain has been given[3] as: film and sheeting 23%; coal conveyor belting 21%; cables and extrusions 20%; coated fabrics 16%; rigid materials (including gramophone records) 12%; flooring 5½%; dipping, injection molding, etc., 2½ percent. The closest rival is polyethylene at 75,000,000 lb., which

[3]British Plastics, 1956, 29, 1-4.

Housing for electric space heater is compression molded in Britain of urea resin. (Photo, British Industrial Plastics Ltd.)





Eye-catching, functional lemon-juice containers are produced of polyethylene by blow molding technique. (Photo, Cascelloid Ltd.)

compares with 40,000,000 lb. a year ago, and an anticipated 140,000,000 lb. by the end of 1957.

Polystyrene at 40,000,000 lb. has not lived up to the expectations of a few years ago. This is to some extent due to the fact that some markets which were conceded to polystyrene perhaps too readily, on account of price and ready availability during the times of difficult supply a few years ago, have been recaptured in part by the tougher cellulose acetate; in consequence of this comeback, the cellulose plastics reached the very substantial production volume of 24,000,000 pounds. In the acrylic field, the recently completed I.C.I. 4,500,000-lb. Perspex plant at Wilton brought the production potential in this branch up to 22,000,000 pounds.

Thermosets still climbing

Although the thermosets have actually been overtaken in the production race, they are by no means in decline. They showed an over-all increase over 1954 of approximately 15%, which was, in general, over all types. Though not spectacular, the increase in phenolics was steady, and production is now around 60,000,000 lb. per annum. Exports of phenolics, both resins and powders, increased, the latter by approximately 25 percent. On the amino plastic side, the resins themselves increased 12% over 1954 to 54,000,000 lb., and exports of resins showed marked improvement from 14,000,000 lb. in 1954 to 24,000,000 pounds.

Polyester resins, which have tended to hang fire in Britain for some time, have attracted renewed interest during the past year. This swing back into more general favor is perhaps stressed by the fact that these materials are now quoted as a separate group in official statistics. These show that production rose from 840,000 lb. in 1954 to 1,600,000 lb. in 1955, but current information indicates that production and sales of polyesters in recent months is at a considerably higher level.

Epoxides have also now seriously entered the field, although much of the available capacity, which is centered on the 4,000,000-lb. Shell plant at Stanlow, is taken by surface coatings and other uses which are not strictly within the plastics field. In the other specialty plastics, such as the silicones and the halogenated hydrocarbon polymers, sound though not spectacular progress has been made. Although no production statistics are available for fluorocarbons, it is significant that I.C.I. is stepping up its production capacity to 400,000 lb. per annum.

According to statistics published by the Working Party on Plastics, which was set up by the Chemical Products Committee of the Organization for European Economic Cooperation, the United Kingdom accounted for 33% of the 1,688,000,000 lb. of plastics sales in Europe in 1954, the other major countries being Germany 38%, France 10%, and Italy 9 percent. This report also shows that the pattern of expansion in Britain follows that which has been observed for Europe as a whole.

Exports of plastics from Britain in 1955 reached the record figure of 166,000,000 lb., valued at nearly £23 million, compared with 148,000,000 lb. in 1954, and 42,000,000 lb. in 1947, and were almost 20 times the 8,600,000 lb. recorded for 1938. These figures include resins, molding powders, sheet, rod, tube, and film, but not molded parts exported as components. Of the individual countries recorded, Australia is still by far the best plastics customer, taking exports valued at £3½ million, while exports in excess of £1 million in value went to South Africa, Denmark, Sweden, and the Netherlands. Substantial increases in sales during 1954 were also made to Italy, Finland, Switzerland, Austria, Eire, and Pakistan.

Machine statistics

Within the Moulders Group of the British Plastics Federation—which does not include all molders—figures show that in 1954 there were 3306 compression presses in operation, aggregating 275,928 tons, compared with 3489 in 1953, aggregating 292,032 tons. By far the largest

number of presses fell between 25 and 150 tons, and only 10 exceeded 1000 tons capacity. On the injection side, 883 machines with an aggregate capacity of 4234 oz. were operated in 1954, compared with 837 and 3884 oz. in 1953. Of the various capacities quoted on the "new basis" in 1954, the 1, 3, 4, and 8 oz. were by far the most popular: only five presses are listed as above 50-oz. capacity. When new statistics are published they may show that there has been a swing in favor of large presses.

The trend in materials is obviously toward self-sufficiency for Britain in plastics. Shell Chemical has now taken a big stake in the industry through its acquisition of Petrochemicals, which holds the license for Ziegler polyethylene in the United Kingdom. Distillers Co., another of the chemical giants, has entered the polyethylene field with a license for Phillips Marlex 50; with Dow it is producing Styron 475 at its South Wales factory in Barry. The availability of this material on the home market has stimulated the production of sheet, and special plants for sheet extrusion have been put down by Ashdowns, B.X. Plastics, Commercial Plastics, and Saro Laminated Wood Products. The latter company has just announced that the American-designed plant, which it has installed at its Cowes (I.O.W.) factory, will have a capacity of the order of 1,600,000 lb. of sheet per annum. Union Carbide has established a plant for the production of polyethylene by the high-pressure process at Grangemouth, Scotland, on a site next to that of the British Petroleum Chemicals.

With so much accent on polyethylene, of both the "soft" and "hard" varieties, it is not surprising that I.C.I., pioneers in this field with basic patents which expired in February, was able to spring a surprise a few weeks ago. This was the announcement of Alkathene "H.D.," a non-catalytic material, the preparation presumably comparing broadly with the high-pressure method. Apart from the increased density, which the name implies, this material is claimed to withstand sterilization at 100° C. The new grade will sell for the present at a somewhat higher price than standard Alkathene, but there could be a price reduction in the near future.

Though polystyrene has not lived up to expectations this year as far as production tonnage is concerned, it is clear that this is but a temporary hold up. During the year the Distrene plant came into production, and Monsanto came forward with its new toughened product, "T 11."

In the more specialized plastics, good progress has been made as measured by increased production. Demands for acrylics for almost all applications have grown steadily, and it is significant that exports have also increased. Although consumption of nylon is still placed are less than 2,000,000 lb. per (*To page* 418)

Plastics in Great Britain

Materials	*Capacity* 1956*	*Capacity* 1955*	*Imports* 1955*	*Exports* 1955*
	1000 lb.	*1000 lb.*	*1000 lb.*	*1000 lb.*
Acrylics	24,000	22,000	120	9600
Cellulosics	12,000	10,600	—	4600
Fluorocarbons	—	100	—	—
Nylons	—	—	—	—
Polyethylenes	—	40,000	—	10,000
Styrene polymers	—	60,000	16,000	19,000
Vinyls	—	100,000	22,200	29,400
Aminos (melamine & urea)	—	30,000	—	23,000
Phenolics (molding, laminating, and industrial resins)	—	130,000	—	6800
Polyesters	—	1600	—	—
Epoxies	4000	—	—	—

*Where no figures are given, none are available, and any accurate estimate is impossible. Of the other figures, some are official, the remainder inferential.

ARGENTINA: restrictions lifted

*By Francisco Masjuan**

Argentine plastics industrialists who have faced enormous difficulties in recent years, difficulties possibly without parallel anywhere else, are now confident that the future will bring great progress. They also believe that conditions now existing will encourage raw materials producers and machinery manufacturers from other countries to install a number of new plants in this young and progressive country.

Thermosets

Compression molders have been able to prepare definite production plans in recent years and when, due to restrictions, it became impossible to import new machinery, the manufacture of compression and transfer presses was begun in Argentina. Today these presses are of excellent quality and generally of the self-contained type. Tabletting machines are also manufactured in Argentina, and the electronics industry has been encouraged to produce preheaters of all types. Our thermoset molding plants are quite modern and efficient, producing everything from small high-precision electrical components to big phenolic laminate sheets.

For several years urea-formaldehyde was available from abroad; when increasing difficulties were encountered in import, local factories were established which are now able to meet present Argentine demand.

Phenol resins have had to be imported for the manufacture of molding powder. Formaldehyde is produced in Argentina by Atanor S. A. and Cia. Química S. A. is now erecting a plant with the cooperation of Farbenfabriken Bayer for the production of phenol. This should solve our problem in the supply of raw materials. At present the country is producing one million pounds of phthalic anhydride and this facility is being trebled in volume. Table I, p. 193, gives an indication of the present production position of the thermoset materials industry in Argentina.

*President, ATMA, Buenos Aires; President, The Argentine Plastics Chamber.

Thermoplastics

Shortly before the beginning of World War II, a few foreign-made injection machines entered Argentina. From that time until 1946 the importation of machinery was completely paralyzed, and only between 1946 and 1950 could equipment be imported to bring this branch of the industry up-to-date. Again, after 1950 it was practically impossible to import any machinery and, what was worse, great difficulties were experienced in obtaining raw materials.

However, Argentine industrialists within the past few years have started to make injection molding machines of small capacity and adequate quality. There is now news of new plants to be established, some of them with foreign licenses (such as Reed-Prentice Corp., which is negotiating a license agreement), to make injection, extrusion, and calendering machines.

Beset by insecurity in supply of raw materials, the thermoplastics process industry was discouraged from developing large injection machines. For the same reason, this was also true of extrusion and calendering equipment. For a long time no imports were possible, and here again local industrialists had to employ great ingenuity to find a local solution to the problem of building extrusion machinery. Nevertheless extruders are being built, and polyethylene film of good quality is manufactured in this country today. There are several other projects for the local manufacture of polyethylene film, some of which involve the investment of foreign capital in Argentina to supply foreign equipment.

At the beginning of 1956 the importation of thermoplastic materials was declared "free" by the government, without any currency restrictions. This created a period of temporary diffi-

culty through economic and industrial adaptation to the new conditions; as a result of this measure, thermoplastic prices have increased in some cases to an almost unbelievable 500% of their former levels.

Since it is now possible to prepare sound production programs with the assurance of availability of thermoplastics, Argentine industrialists, who have certainly distinguished themselves for aggressiveness and initiative, will soon find a way to recuperate time lost during the period of restrictions. And if present restrictions affecting importation of machinery continue, factories will be developed to produce necessary equipment and even new techniques. The whole thermoplastics industry in Argentina is looking forward to being able to work with locally made raw materials.

Monsanto Argentina S. A., a subsidiary of Monsanto Chemical Co., is installing a factory for the polymerization of styrene monomer, and production is expected to begin during the second half of 1956. Industrias Plasticas Argentinas Koppers (IPAK) S. A. has been constituted under the direction of Koppers Co., Inc., and will commence production of the same material in 1957. This means that at least one basic raw material for injection molding will be produced in the country, although initially the monomer will have to be imported.

It is also expected that much more ethylene will be available from Argentina's petroleum industry, while the large steel works now under construction should provide a good supply of benzene.

In addition to a small local production of vinyls, there are several large-scale projects of which one, under license from Imperial Chemicals Industries Ltd., and another under license from Produit Chimiques et Electrometallurgiques Pechiney, are at an advanced stage. Since these projects are based on the availability of domestic raw materials, it is estimated that production will not be under way for at least two years.

In view of these possibilities, and in view of the excellent market for vinyl film, manufacturers are expanding their plants and adding complementary equipment, such as printing presses, in order to be ready to take advantage of future prospects, while covering present demand by processing imported material.

Negotiations are under way with an important Italian firm for the installation of a factory for the manufacture of cellulose acetate.

Local molders are hoping for the establish-

Table I: Thermoset production in Argentina

Manufacturer	*Material*	*Annual capacity, lb.*	*Location*
	Phenolics		
Monsanto-Atanor S.A.	Molding powders	2,205,000	Munro[a]
	Resins	2,205,000	
Industrias Químicas Plastiversal S.A.I.C.	Molding powders	2,646,000	Sarandí[b]
	Sheets, laminates, etc.	4,410,000	San Nicolás[c]
Plastica Bernabó S.A.	Molding powders	2,646,000	Buenos Aires
Establecimientos Plasticos Argentinos S.A.	Molding powders	1,587,600	Quilmes
	Galalith	793,800	
Celusina S.A.	Molding powders	1,058,400	Casanova
Cia. de Productos Conen S.A.	Molding powders	529,200	Avellaneda
	Urea		
Monsanto-Atanor S.A.	Resins	1,323,000	Munro[a]
Patricios S.A.C.I.A.F.	Molding powders	3,969,000	Lanús
	Adhesives & resins	2,646,000	
Fábrica Argentina de Productos Industruales (FAPI) S.A.	Molding powders	198,450	Bernal
Quimpla S.R.L.	Molding powders	771,750	Sarandí
	Adhesives	793,800	

[a]Know-how from Monsanto Chemical Co.
[b]Know-how from Imperial Chemical Industries Ltd.
[c]This company has signed an agreement with B.I.P. Chemicals Ltd. to develop all products of this English manufacturer in Argentina, especially urea resins (powders) and melamine.

Table II: Plastics supply in Argentina

Material	*Capacity, 1956* lb.	*Local production, 1955* lb.	*Imports, 1954/5* lb.
Acrylics	800,000[a]	—	3,300,000
Cellulosics	3,000,000	—	4,100,000
Fluorocarbons	—	—	—
Nylons	100,000	—	Not available
Polyethylene	5,000,000	—	3,500,000
Polystyrene	8,800,000	—	5,900,000
Vinyls, including plasticizers	10,000,000	—	6,300,000
Aminos — Urea	750,000		
Aminos — Melamine	2,700,000	2,400,000	—
Phenolics	5,500,000	5,000,000	
Polyesters	—	—	Small
Epoxies	—	—	—

[a]As there were no large injection or vacuum forming machines in use, acrylic was used in large-size sheet. With new facilities coming in, other materials, especially polystyrene, will replace acrylic.

ment of facilities for the manufacture of polyethylene in Argentina. Some projects are under study, one of which seems about ready to become a reality.

In thermoplastic sheet forming and in reinforced plastics, private enterprise has been unable to do much because of import difficulties. However, a semi-official organization has been employing reinforced plastics in the small-scale manufacture of automobile bodies and speedboats. And it is understood that this year several vacuum forming machines will begin working; at least some of these will be locally made.

Table II, above, prepared from statistics supplied by the Cámara Argentina de la Industria Plástica, shows the present and imminent plastics supply picture. Table III, below, presents statistics of the processing phase of the industry, the figures coming from the same source.

Table III: Argentine processing plants and equipment

Facility	*1955*
Number of molding, extruding, and fabricating plants	620
Number of injection presses	615
Number of extrusion machines	147
Number of compression presses	2459
Number of calenders	5

In 1945, one year after the foundation of the Argentine Chamber of the Plastics Industry, 62 members were registered, although actually the number of eligible firms considerably exceeded this number. At present, the Chamber includes 450 members and represents some 10,000 workers. Many of these firms are of the same small-capacity type which are numerous in New England, having only one or two machines, but some are good-size factories employing from 150 to 500 workers.

One of the characteristics which is typical throughout most of South America is that each factory has its own tool room to produce its molds, jigs, and fixtures. Until recently there were no specialized independent tool makers, as exemplified by the case of a factory employing 450 workers in which there are 50 men in the tool room making dies and accessories. Lately this picture has been changing and specialty die-making companies have been established.

During the difficult years between 1945 and 1952, the Argentine Chamber of the Plastics Industry represented the interests of the entire plastics industry in its dealings with powerful labor union organizations. The Chamber is presently expanding its facilities and is planning a permanent exhibition of plastics, with more than 80 independent stands and show cases, in which even the smallest manufacturer's products would be exhibited. In addition, the Chamber plans to prepare two programs of publicity: one on technical matters and the other of a general nature to educate the public in the use of plastics.

Cutting costs on a cover

Reinforced plastics component of telephone unit proves superior to equivalent part fabricated of metal

Greater strength at half the weight, improved design, easier assembly and installation, lower noise level, and reduced production costs—these were the results of a switch from metal to polyester-fibrous glass laminate for the cover of the Bell System Type 1A1 key telephone unit. The cover, measuring about 26 in. long, 17 in. wide, and 9 in. deep, fits over a wood base on which are mounted relay switches and other components. These devices comprise an "automatic switchboard" that connects internal and external telephones into many combinations of circuit hook-ups without human operators.

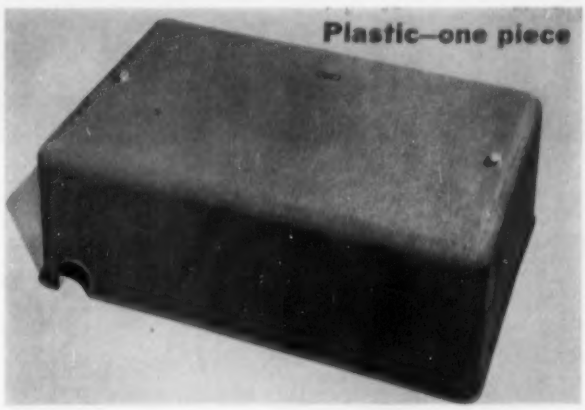
Better performance at lower cost

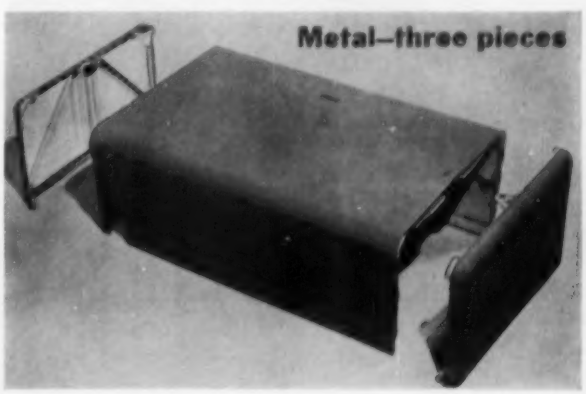
The metal cover which had originally been intended for the job was made up of two ⅛-in. thick die-cast end plates and a body formed from 18-gage sheet steel. Assembling these metal covers required binding flanges on the ends; punching a U-shaped cut-out for cables; drilling holes; assembling and riveting the parts; and sanding, corrosion-protecting, and seam-caulking prior to finishing.

By contrast, the reinforced plastic cover is molded in one piece. The U-shaped cut-out and fastening holes are molded-in, eliminating the six assembly operations required to put the metal cover together. A molded-in flange around the bottom of the cover also improves assembly efficiency. The flange, which fits over the edge of the base plate, speeds up assembly by helping to center the cover squarely on the base plate. The flange was not incorporated in the metal model, since it would have required several additional forming and machining operations.

Lowered production cost, however, is only one advantage accruing from the switch to plastics. Improved strength is another. In tests conducted by Bell Labs., weights dropped on the metal cover assembly sheared the rivet heads off; the same weights left the polyester cover unmarked and undamaged. While the polyester cover has enough resiliency to support the weight of a man easily, the 18-gage metal cover would normally dent or buckle under the same conditions.

Greater strength and resiliency also makes it possible to eliminate in the design of the reinforced plastics cover the oblique struts which had to be fastened to the (*To page* 422)





One-piece telephone box cover of polyester-glass (above) has all necessary openings molded-in. Three-piece metal cover (below) requires many assembly and finishing operations. (Photos, Western Electric Co.)

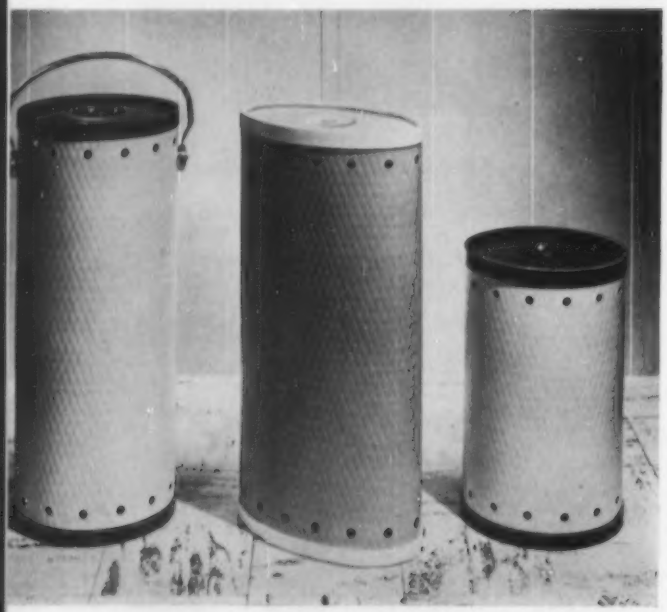
Butyrate handle for automatic waxer

A lightweight, transparent extruded butyrate tube serves as the handle of a new automatic wax applicator which eliminates much of the drudgery in home floor upkeep. The handle holds up to a pint of liquid wax; gentle pressure on the handle releases the liquid through a special non-clogging valve just above the waxing pad.

The transparency of the handle permits the user to see at all times how much liquid wax is available for use. Fittings at either end are molded of butyrate and polyethylene. Without wax, the complete device can be used as an overhead duster or a wet or dry mop.

Credits: Wax-Wiz manufactured by Pionair Products, Inc., Chicago, Ill.; handle extruded by Crescent Plastics, Inc., Evansville, Ind.; fittings molded by Korris Products, Inc., Lyons, Ill.; Tenite butyrate and polyethylene supplied by Eastman Chemical Products, Inc., Kingsport, Tenn.

PLASTICS



Three materials in hampers and baskets

A new concept in styling and engineering of hampers and waste baskets makes use of vulcanized fibre, styrene alloy, and vinyl plastisol to produce durable items of great beauty.

The materials are light in weight, yet practically impervious to scuffs, mars, stains, nicks, and dents; will not rust or corrode, and are resistant to oil, alcohol, gasoline, and most known solvents.

The hampers and baskets have molded bases and covers of high-impact styrene. Surfaces, inside and out, are sprayed with vinyl for a smooth finish. Diamond-like design is the result of an embossing operation. Items are available in a variety of sizes and colors including pink and gold (with charcoal trim), and mist blue, turquoise, charcoal, and burnt orange (with chalk-white trim).

Credit: Vulcot hampers and baskets manufactured by National Vulcanized Fibre Co., Wilmington, Del.

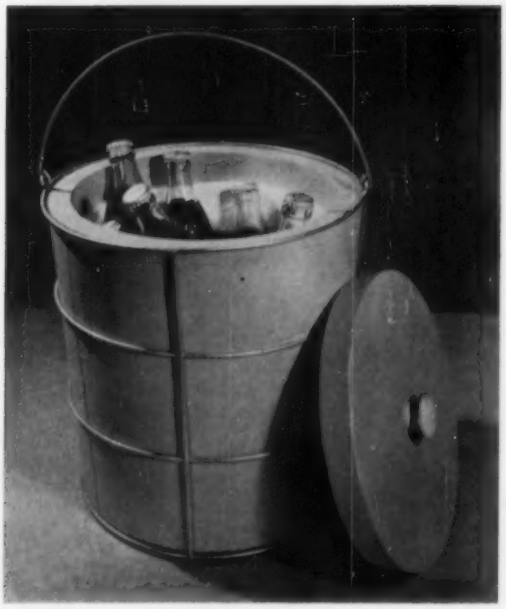
Plastic parts for optical hobby kits

Molded butyrate lens frames and various stands and holders are among the parts included in a hobby kit developed to amuse youngsters while introducing them to basic principles in the field of optics. The butyrate parts, designed to withstand rough handling, are molded in a 12-cavity mold on a 16-oz. HPM machine. One complete set of parts is molded in each run.

In addition to all the components necessary to conduct many light experiments, the kit contains a booklet prepared by Encyclopedia Britannica which describes how to assemble such optical devices as a magic lantern, telescope, microscope, periscope, signaling spotlight, and many others.

Credits: American Optical Kit No. 1 manufactured by American Optical Co., Southbridge, Mass.; distributed by "Industrial America," Inc., Chicago, Ill.; Tenite butyrate supplied by Eastman Chemical Products, Inc., Kingsport, Tenn.

PRODUCTS



Expandable styrene minnow bucket

A combination minnow bucket for fishermen and portable cooler for use at parties and picnics is molded of expandable polystyrene. The use of expandable styrene for this application has resulted in a bucket with exceptional insulating qualities; according to the manufacturer, minnows can be kept alive longer in this bucket than in any other minnow bucket. As a cooler, it will keep its contents cold for days at a time without the addition of ice. It will also prevent liquids and other materials from freezing even at sub-zero temperatures.

The buckets are light in weight and extremely buoyant. Complete with its metal carrying bracket, the 10-qt. capacity bucket weighs less than two lbs. and is sufficiently buoyant that even when filled with water, it will keep a 200-lb. man afloat.

Credits: Manufactured by Stevens Plastic Products, Inc., Manitowoc, Wis.; Dylite expandable polystyrene supplied by Koppers Co., Inc., Pittsburgh, Pa.

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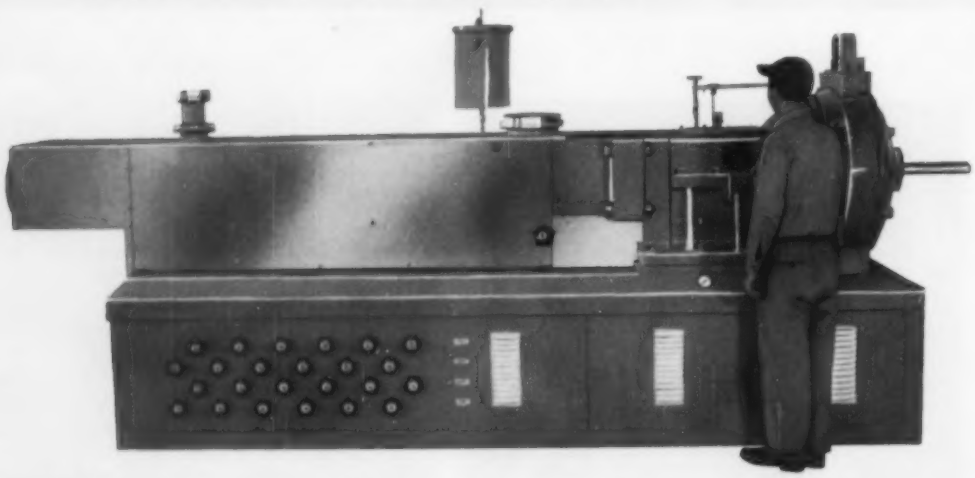

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Plastics Engineering

Dr. James F. Carley, Engineering Editor

TENSILE-IMPACT:

a simple, meaningful impact test

By C. G. Bragaw†

Here is a report giving the full details on the new tensile-impact test that we hailed in our editorial on p. 149 of the April issue. Izod impact-testing equipment can be inexpensively modified to permit impact testing of a variety of test specimens in pure tension. This simplifies interpretation of test results and makes it possible to isolate for study many special effects (like notch sensitivity) connected with impact behavior. Values for typical plastics vary from 39 to 2000 ft.-lb./cu. inch. Test results check well with results of end-use impact tests of plastic articles. It is shown that Izod-test results may often be predominantly indicative of notch sensitivity rather than the ability of the material to withstand shock loads.

One of the most distressing problems that confronts an applications engineer is the problem of how to design and select materials to withstand impact loadings. Many previous investigators of impact properties have selected tensile experiment as an approach[1,2]; the stress system is simple, the strain rates are known, and it is general knowledge that impact-loading failures are usually tensile failures.

In an effort to achieve high rates of loadings and to provide flexibility, elaborate apparatus has been used, or notches of various shapes have been cut in the samples. A large number of impact tests have been devised, including: notched-cantilever-beam tests, simple-beam tests, ski-ball tests, tests in which balls are fired through films, tests in which shock waves in compressed gas apply load, service-use tests, and so forth. It is my purpose here to report on a surprisingly simple test which satisfies the long-felt need for impact testing under clear-cut tensile stresses. At the same time, it retains the advantages of the Izod test: it gives a single index number; testing is quick and economical in terms of specimens and manpower; the equipment is easily standardized and is cheap.

Test method and specimens

To apply this new tensile-impact test, it is only necessary to add four small and inexpensive metal adapters to a standard Izod impact tester. Figure 1, below, is a diagram of a conventional Izod arrangement. The hammer swings as shown. Figure 2, below, shows

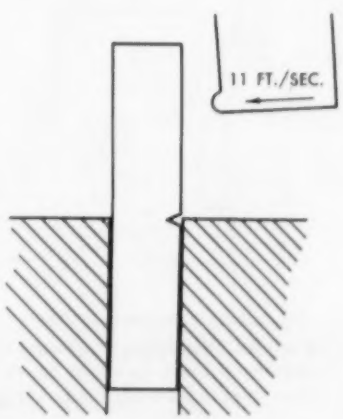


Fig. 1 (left): Arrangement for Izod impact test

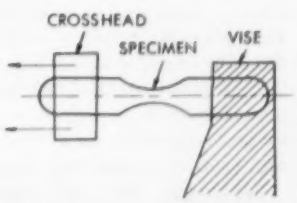


Fig. 2 (above): Tensile-impact test set-up

Based on a paper presented at the 1956 Annual Convention of the S.P.E. at Cleveland.
*Reg. U. S. Pat. Off.
†Polychemicals Dept., E. I. du Pont de Nemours & Co., Inc., Du Pont Experimental Station, Wilmington, Del.
[1]B. Maxwell and J. P. Harrington, Trans. A.S.M.E., 74, 579-87 (1952)
[2]B. Maxwell, J. P. Harrington, and R. E. Monica, S.P.E. Journal, 8, 22, (Dec. 1952).

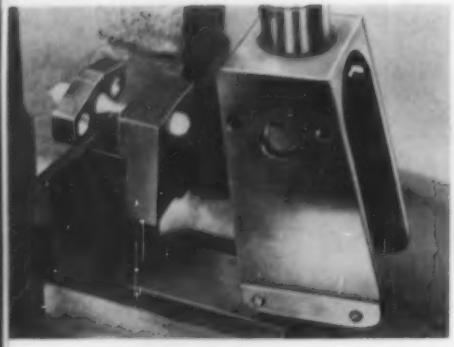


Fig. 3: Tensile-impact apparatus in operation

fibers. Most of the specimens tested in this work had one form, but the equipment can be adapted to test almost any shape cross section. Figure 5, below, shows the size and shape of specimens used in our tensile-impact experiments. The necked test section has a contour such that the stress-concentration effect is about 5%[2], yet the gage length is short. Using the classical theory of elasticity it can be calculated that in the elastic range the injection-molded specimen behaves as though it has a 0.43-in. gage length (0.53 in. for film specimens). The use of this theory is justified by two considerations. First, investigations using a load cell to measure stress-strain relations during tensile-impact show that at these high strain rates most materials behave elastically up to the point of fracture. Second, the elastic-region behavior also determines the draw characteristics when there is draw.

The tensile-impact strength is

[2] R. E. Peterson, "Stress Concentration Design Factors," J. Wiley & Sons, N. Y., 1953.

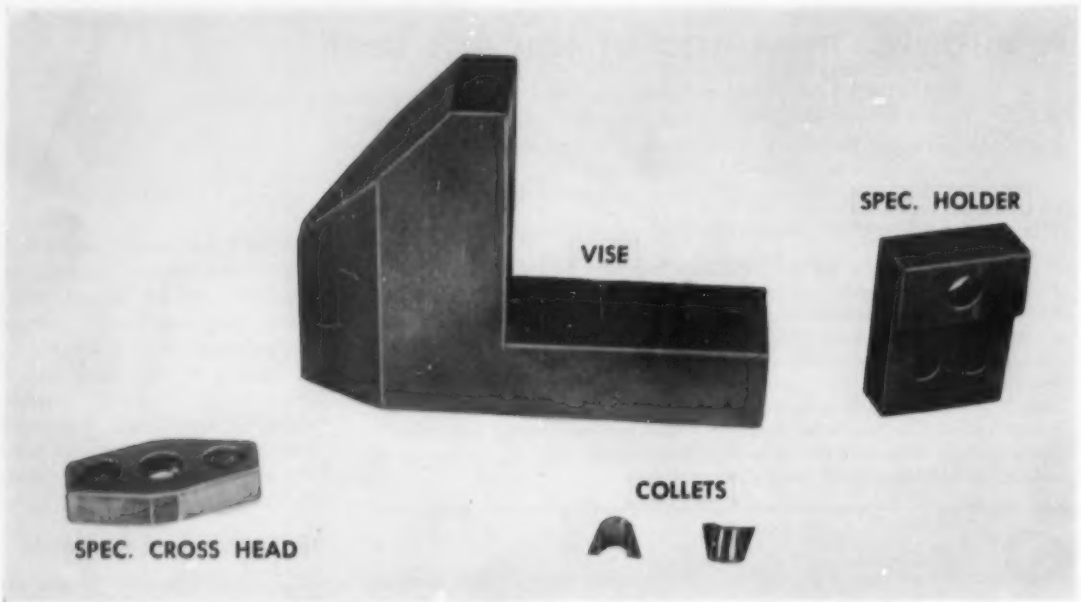
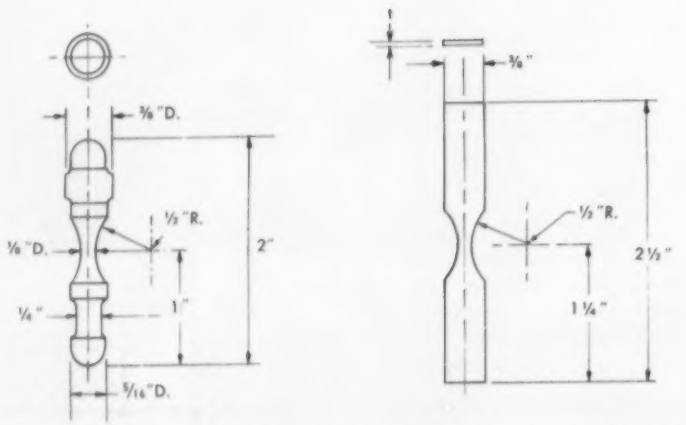


Fig. 4: Various adapters needed for tensile-impact test

the revised arrangement. The hammer swings as before, but this time hits a crosshead, breaking the specimen in tension. The specimen end and crosshead fly, so a small correction for the kinetic energy of toss is needed. By making the crosshead of magnesium, the correction is kept small; it averages 0.05 foot-pound. The specimen-breaking energy can be estimated with less than 1% error, which is less than the specimen-to-specimen variation. Figure 3, above, shows the revised apparatus in action, and Fig. 4, above, shows the adapters.

Specimens may be injection molded; they may be cut from films, from moldings, or even from



5/16" INJECTION-MOLDED SPECIMEN COMPRESSION-MOLDED FILM SPECIMEN

Fig. 5: Dimensions of specimens for tensile-impact test. Compression-molded film specimen has thickness $t = 1/32$ in.; specimens cut from thinner films are stacked to give about this total thickness

Table I: Tensile-impact strengths of some commercial materials[a, b]

Material and supplier	Tensile-impact strength			Izod impact strength		
	Average	Std. dev.	Number of specimens	Average	Std. dev.	Number of specimens
	ft.-lb./cu. in.			ft.-lb./in.	ft.-lb./in.	
Akulon* K-2 nylon resin Algemene Kunstzijde	337	47	10	[>6 cond.]		
Alathon* 10 polyethylene resin Du Pont	244	21	10	(no break)		
Aluminum: #24 SO Alcoa	656	33	4	51.8	0.8	4
Ethocel* LT6 ethyl cellulose resin Dow	95	19	10	(5.0)		
Haveg* 41 asbestos-filled phenolic resin Haveg Corp.	35	12	10	—		
Kralastic* B modified styrene resin Naugatuck Chemical	147	18	10	(5-9)		
Kralastic* F modified styrene resin Naugatuck Chemical	86	13	10	2.7 (3-6)	0.8	10
Lucite* 140 polymethyl methacrylate Du Pont	93	7	10	0.33	0.19	10
Micarta* #262 Grd. C Westinghouse	165	18	10	(2.7)		
Mylar* polyester film Du Pont	957	158	10	[can't make test piece]		
Neoprene rubber Du Pont	810	67	5	(no break)		
PVC (rigid) American Agile	119	15	10	—		
PVC ASTM Type I Grd. 5 Bakelite	578	24	10	(no break)		
PVC ASTM Type II Grd. 18 Bakelite	418	11	10	(no break)		
Phenolite* CE578 Nat. Vulcanized Fibre	90	9	10	1.65	0.2	5
Plexiglas* V100 polymethyl methacrylate Rohm & Haas	83	9	8	(0.4)		
Polyester-glass rod (oriented) Montague Rod and Reel Co.	2000	40	3	(~15)		
Styrene* TMD 2155 polystyrene resin Bakelite	156	23	20	(8.0)		
Styron* 475 polystyrene resin Dow	67	14	10	(2.3)		
Styron* 666 polystyrene resin Dow	59	6	10	(0.43)		
Teflon* 1 tetrafluoroethylene resin Du Pont	905	176	4	(3.0)		
Tenite* I cellulose acetate resin Tenn. Eastman	160	40	10	3.3	0.95	10
Tenite* II 205 AMS cellulose acetate butyrate resin Tenn. Eastman	167	46	11	(3.0)		
Zytel* 101 nylon resin Du Pont (Conditioned to equilibrium at 23°C, 50% RH; final water content=2.4%.)	365	86	13	2.66 (2.0)	0.5	5

[a] Measured at 23° C. and 50% relative humidity.

[b] Izod values in parentheses are values given in the literature. All others were measured by the author and fellow workers.

* Reg. U. S. Pat. Off.

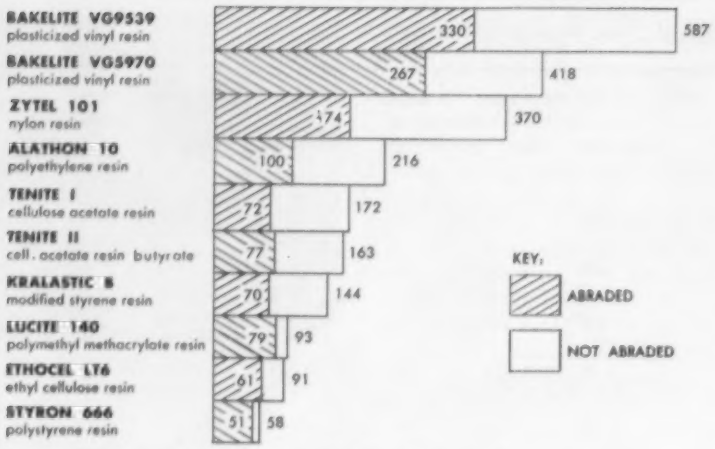


Fig. 6: Effect of surface abrasion on impact strength

readily calculated by dividing the measured total energy absorbtion by the known specimen "active" volume.

Wide range of stiffness

One of the limitations of the Izod test is that only materials having a limited range of stiffness can be tested. Soft materials like rubber and polyethylene will not stand up to the Izod hammer at room temperature, but will bend and twist sideways and therefore escape the full force of the blow.

A tensile-impact test by the nature of its stress system permits a common-basis rating of materials having a wide range of rigidities: rubber, polyethylene, polystyrene, thermosets, and even steel, for example. Typical test results for unnotched specimens are listed in Table I, p. 201. Readers familiar with the Izod ratings of plastics will see some startling changes in rank in the tensile-impact half of this table. Note, for example, that Kralastic F, Lucite 140, and Phenolite CE578 are practically identical in their ability to withstand tensile-impact, yet their Izod ratings spread over an 8-fold range! This spread must reflect big differences in notch sensitivity, but notch sensitivity is often irrelevant in impact service. The extremely high value of 2000 ft.-lb./cu. in. for a polyester-glass laminate with oriented fibers will not surprise those who know that reinforced plastics are tough even though they are rated far lower than aluminum by the notched-Izod test.

Spread is important, too

Table I also lists the standard deviations of the two impact tests for six materials. Except for Kralastic F and Lucite, there are no statistically significant differences between the two tests in respect to standard deviation. In those two cases, however, the differences are very large, in favor of tensile-impact.

Fig. 7: Schematic drawing showing arrangement for drop testing of injection-molded tumbler

Expressed as percentages of the average values, the standard deviations for the different materials in the tensile-impact test vary from 2.6% (PVC A.S.T.M. type II) to 34% (Haveg). Statistical testing of the data shows that these standard deviations in impact strength are distinctly characteristic of the particular materials, just as their impact strengths are. Both the average and standard deviation are needed, therefore, to fully describe the impact behavior of any material.

The part designer hopes that the material he chooses will fail only occasionally in service, say 1% of the time. For his purposes, not the average value, but a lower one—the "1% confidence limit"—should be used. This limit is found by subtracting about 2.8[4] times the standard deviation from the average.

Small samples will serve

There is great freedom of choice of size and form of test specimens. Because tensile-impact specimens do not need lateral rigidity, film can be used. Fundamental studies of the effects of microstructure and of fabrication conditions are possible. It is possible to test small samples of new materials. Recently, molecular-weight fractions of a polymer weighing only 5 g. each were successfully tested in our laboratory! Studies on small samples can give data on anisotropy, the directional variation in properties. Testing of small sections cut from large moldings (for example, a plastic suitcase end) can yield valuable information about molding effects. If weld-line strength is to be investigated, injection into the specimen-mold cavity from both ends places the weld line in the test section. And so on. The interpretation of fundamental studies is made easier because the stress system is simple and the strain rate is known.

Isolates notch sensitivity

Because of specimen geometry, impact strength can now be evaluated apart from notch sen-

[4]The value of this factor depends on the number of specimens tested, the confidence level, and on the normality of the distribution of impact strength. Confidence limits are discussed in all statistics texts.

sitivity. If the effects of notching or abrasion are to be evaluated, suitable specimens can be prepared. Figure 6, p. 202, shows how severe circumferential abrasion made by hand-rubbing with #80 emery reduces impact strength. This degree of abrasion is about the same as that which would be produced by dragging a suitcase along a very rough concrete platform. The more "brittle" materials such as polystyrene and methacrylate are affected less than the more ductile materials.

Table II: Low-temperature impact testing of moldings* (drop test vs. lab. tests)

Material	*Use test drop height*	*Standard tensile-impact*	*Standard Izod impact*
	ft.	*ft.-lb./cu. in.*	*ft.-lb./in.*
Ethocel® LT61 ethyl cellulose resin	2.0	119	2.7
Kralastic® F modified styrene resin	2.1	128	5.6
Zytel® 101 nylon resin	5.2	212	0.4

*All measurements were made on dry (as-molded) materials at −25° C.
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Test checks performance

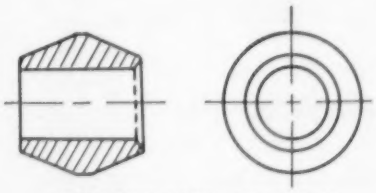
Perhaps most important of all, tensile-impact ranks materials in an order compatible with the order of impact strengths encountered in practice. As an illustration of this, consider the impact resistance of injection molded plastic tumblers (Fig. 7, p. 202). Tumblers are representative of a large number of commercial moldings in that their molding requires the molten plastic to make a right-angle bend in filling the mold and also involves a long flow in a thin section. To simulate a severe use-test of a similar molding, tumblers were weighted heavily and allowed to fall so as to strike corner-first on a steel surface. The metal weighting slugs were shaped so that the tumbler was not supported at the corner (see Fig. 7, p. 202); the material was thus subjected to a sudden bending stress right at the corner. Three polymers were tested: Zytel 101 nylon resin, a commercial impact-grade ethyl cellulose, and a general-purpose styrene-acrylonitrile-butadiene copolymer. The tumblers were tested "as molded," the Zytel 101 nylon resin being nearly bone dry and thus least tough in this condition. Testing temperature was −13° F. (−25° C.). The temperature and humidity approximated winter conditions in Denver.

Table II, right, compares the results of the use test with Izod- and tensile-impact strengths. The drop heights given are the heights at which 50% of the specimens failed. It is clear that the drop-test agrees much better with the results of the tensile-impact test than they do with those of the Izod test. Since only three materials were tested, statistical significance cannot be established.

In a second use-test comparison we were more fortunate in having six materials to test. The piece tested was a plastic roller for an automobile door latch (Fig. 8A, below); this roller is slammed against a wedge every time the auto door is closed. Specimens were molded from six commercial resins offered for use in impact service. Before testing, dry specimens were conditioned seven days at the A.S.T.M. standard conditions of 73° F. (23° C.) and 50% relative humidity. The test method consisted of dropping a 1200-g. steel weight from various elevations (Fig. 8B, below) and thus determining the height necessary to cause 50% of the specimens to fail. The results are given in Table III, p. 206, and shown graphically in the scatter diagrams of Fig. 9, p. 206.

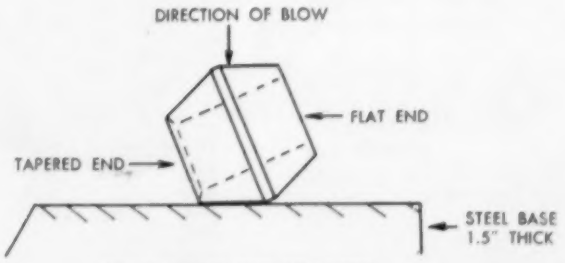
Here again the use test shows much better agreement with the tensile-impact test than with the Izod test. To see just how good the correlation is in each case, the correlation coefficient for each of these diagrams was calculated, assuming linearity. This is a measure of how closely the two variables follow a straight-line relationship. Naturally, since all three of these tests give numbers that increase as the energy absorbed increases, positive correlations should be expected. In the case of the Izod test, the calculated correlation coefficient is −0.12 for these data, an unreal value not significantly different from zero. Even allowing for a large sampling error, it is highly unlikely that the Izod test would ever exhibit a strong positive

(*To page* 206)



AUTOMOBILE DOOR LATCH ROLLER

Figs. 8A (top) and 8B (below): Schematic drawings of auto doorlatch roller (top) and test



ROLLER IMPACT TEST SCHEMATIC

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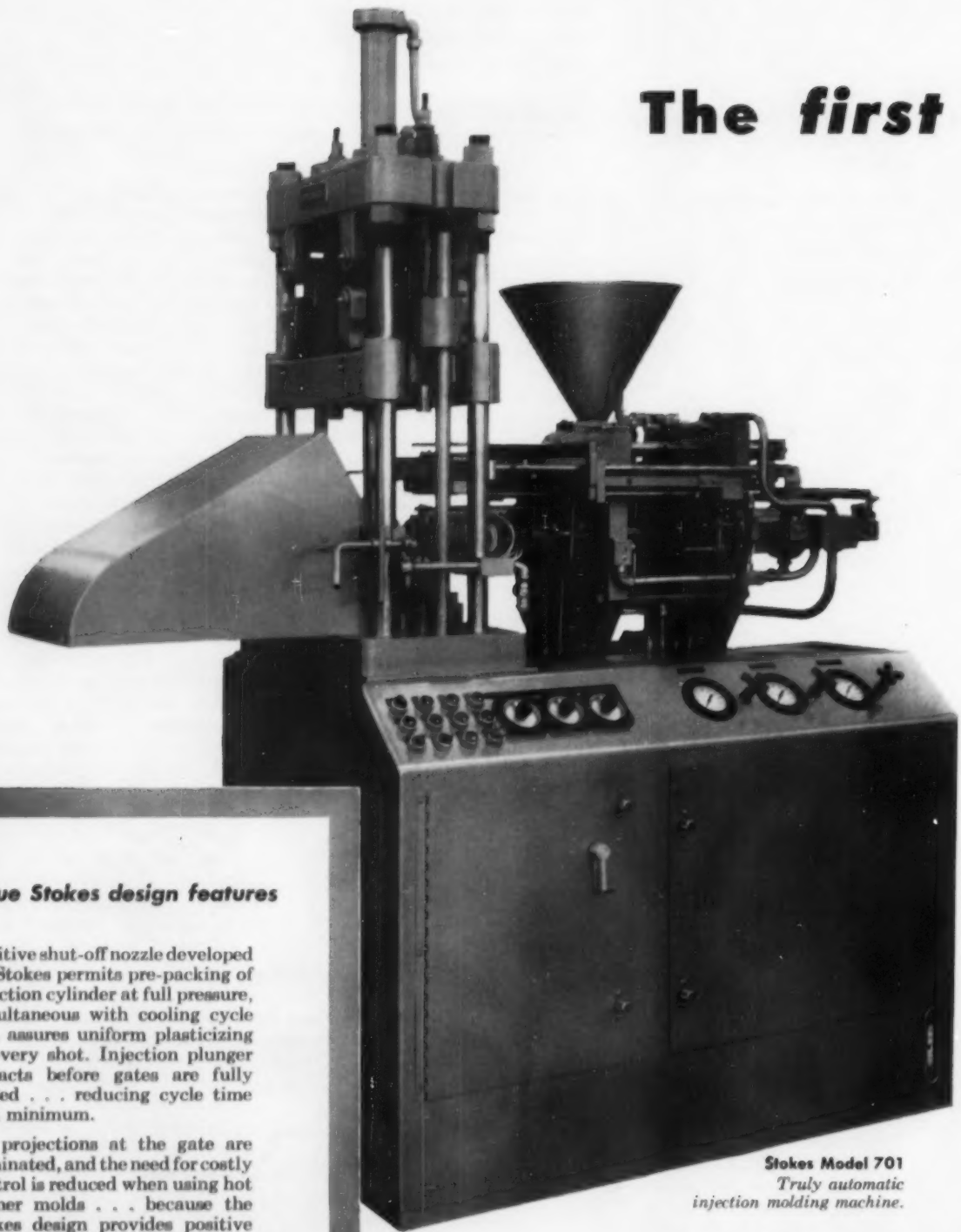

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Table III: Impact testing of injection moldings[a] (drop test vs. lab. tests)

Material	*Doorlatch roller drop height*	*Standard tensile impact*	*Standard Izod impact*
	cm.	*ft.-lb./cu. in.*	*ft.-lb./in.*
Ethocel* LT61 ethyl cellulose resin	22	95	2.8
Kralastic* F modified styrene resin	21	147	6
Styron* 475 polystyrene resin	8	68	2.5
Tenite* I cellulose acetate resin	55	158	3.3
Tenite* II cellulose acetate butyrate resin	100	167	7
Zytel* 101 nylon resin[b]	110	186	1

[a]Tests were made at 23° C. and 50% relative humidity.

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[b]Conditioned by exposing dry moldings to 50% R.H. at 23° C. for 7 days (final water content is approximately equal to 0.35%).

correlation with performance in the doorlatch roller test.

The second diagram of Fig. 9 shows a much stronger, though not perfect, linear correlation of +0.84 between the tensile-impact results and those of the use test. The "best" straight line is dashed in. The solid curve, however, represents a more likely form of relationship between these two tests, since it seems inevitable that as the drop height approaches zero for a given material, so must its tensile-impact strength. Thus the true relationship should start at the point (0,0) of the graph. In addition, the door rollers were injection molded around a core and were found to be especially weak at the gates and weld lines. The tensile-impact test bars had no weld lines and their gate regions, at one end of each specimen, were not stressed during the test. Thus a material may have a substantial tensile-impact value yet fail at rather low drop heights in the use test because of the weakness at gates and weld lines. This helps explain why a simple curve of this shape fits the data better than the "best" straight line (for curves shown, R = +0.91).

In the light of these results, the data in Table II, by extension, take on more weight. As has been shown, the form of the relationship between the tensile-impact test and performance in a particular application may depend on the design of the part and, perhaps, on molding conditions. But we *can* expect that tensile-impact will correctly *rank* materials for many applications.

Engineering for impact service

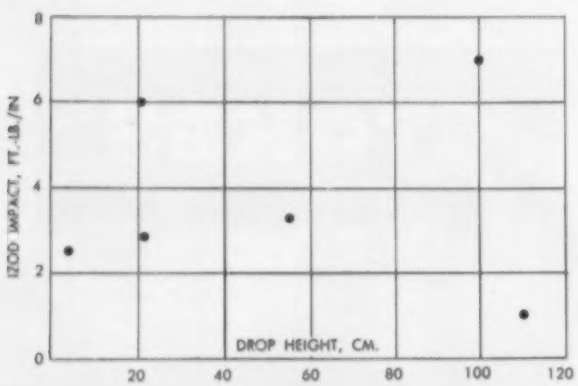
A complete knowledge of the engineering aspects of impact service would enable one to inspect a proposed new design for an impact-resistant part, assign numerical values to stresses, strains, and strain rates, and by reference to compilations of material properties select a material which would be adequate for the service. Today's design tools are far from this goal. Not only do they lack a sufficiently complete catalog of material properties, but the art of stress analysis is not far enough advanced to allow a complete description of the time-dependent stress and strain functions for an impact-loaded complex shape, like, for example, a water tumbler.

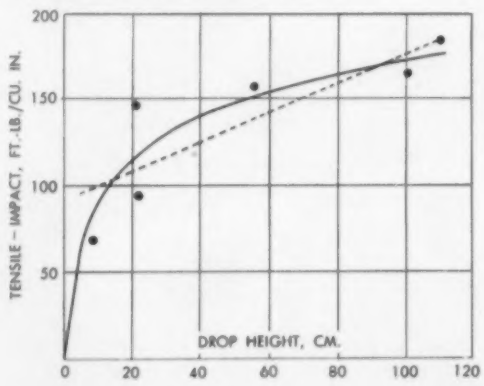
Not having complete knowledge, we are forced to use simple tests to establish rankings of materials which are consistent with the rankings established by experience in impact service, and, where possible, by quantitative service testing. The usefulness of the tensile-impact test is that it gives a more realistic index of behavior in common impact situations. However, only the relative performance is indicated; to establish an absolute level of performance it is still necessary to make at least one prototype experiment.

Conclusion

A simple adaptation of the standard Izod impact tester permits the testing of plastics in tensile-impact. The tensile-impact test permits easier theoretical interpretation of results, has great versatility in regard to studies possible and plastics which can be tested, permits isolation of effects due to notch-sensitivity, uses equipment which is widely available, and correlates well with actual applications experience.

Fig. 9: Scatter diagrams showing relation of Izod impact (left) and tensile-impact test results (right) to roller drop test results. Curve indicates likely form of relationship between first two





Silicone alloys— new engineering materials

*By Charles L. Petze, Jr.**

Alloys of silicones with other polymers have outstanding ability to keep their mechanical and electrical properties during long-continued exposure to weather and sea water. In particular, surface resistivity, a property sensitive to surface contamination or degradation, is not lowered by 12 months or more of outdoor exposure. The new alloys are tough, resistant to high temperatures, extremely dimensionally stable, and can be extruded and molded with ease. Some of them are self-extinguishing; most are inexpensive. They have met the challenges of service as outdoor and undersea insulating materials.

Plastics offer many advantages for industrial and engineering purposes, but most of the materials have suffered from some deficiencies in dimensional stability, heat resistance, and maintenance of physical and electrical properties under continued use indoors and out. Not even the most expensive plastics materials had all of the properties demanded by some important applications.

It was in part such considerations that encouraged us, more than six years ago, to undertake work to develop improved polymer compounds. Among the results of this effort is a new family of materials—alloys of silicones with other polymers—on which composition-of-matter patents are pending. The silicones confer the novel properties which the alloys possess, with a range of general properties provided by the other constituents—which may be as different as vinyl polymers and copolymers, polyethers, ethylenic polymers. Thus the name, silicone alloys. The intent has been to design these alloys to provide new engineering materials characterized by toughness, dimensional stability, weatherability, and good surface and processing properties, and to make them especially useful in electrical, electronic, and structural applications. The particular alloys described here are thermoplastics intended for molding, extrusion, and vacuum forming. Data on physical and electrical properties representative of several compositions are given, respectively, in Tables I and II, p. 208.

The alloys are produced readily in conventional large-scale equipment and may be compounded in Banbury mixers and similar units. Consequently, commercial quantities of several alloys are available at prices of 70¢/lb. or less, with a near-future expectation—barring inflation—of substantially lower prices as production increases.

Molding applications

The silicone alloys were first developed for use as dielectric and insulating materials where repeated immersion to substantial depths in sea water, followed by exposure to wind and sun, is experienced. It is not sufficient for such uses that the insulating material have a high resistivity, a low loss factor, practically no water absorption, and be highly water repellent when clean. Submarine antenna-support insulators (Fig. 1, p. 210), for example, must have a high surface resistance within a few seconds after a whip antenna is raised above the surface of the sea. It also must not accumulate a continuous film of foreign matter on its surface nor undergo crazing or cracking to form paths of low resistivity. These requirements, as well as the desire to reduce the cost per insulator to substantially less than that of the fluorocarbon originally used for this application, early in our work led to active support of the development program by the Electromagnetic Systems Division and the Submarine Antenna Branch of the Underwater Sound Laboratory of the United States Navy.

The fluorocarbon insulator—exceptionally good when clean—accumulates a surface film when exposed at sea and within six months its surface resistance falls to an undesirably low value. Further, the surface resistance recovers too slowly after immersion. But the silicone alloy, better retains its equally high initial surface resistance for a full year (and even longer) as shown in Fig. 2, p. 210. In addition, it recovers much more rapidly to higher resistance after contamination and immersion. Incidentally, the cost of an antenna insulator bushing made of the silicone alloy is about one-third the cost of the fluorocarbon bushing.

The graph in Fig. 3, p. 212, was constructed by computing and plotting the ratio of the value of surface resistance for the silicone alloy to the value for the fluorocarbon, measured at various time intervals after application of power. In 30 sec. the resistance of the alloy is 10 times that of the

*Chairman, Delaware Research & Development Corp., Wilmington 3, Del.

Table I: Physical properties[a]

Property	Alloy A: Medium impact	Alloy B: Relatively high impact	Alloy C: Low loss	Alloy D: High temperature
Specific gravity	1.04	1.04	1.05	1.3
Tensile strength, p.s.i.	3750	4310	6410	4130
Elongation, %	39	62	10	39
Flexural strength, p.s.i.	5690[b]	5380[b]	9710	6790
Modulus in flexure, p.s.i.	362,000	224,000	452,000	183,000
Hardness, Rockwell L scale	68	[d]	101	[d]
Hardness, Shore D, 10 sec.	78	71	84	72
Water absorption, %, 24 hr.	0.15	0.15	0.06	0.01
Heat distortion temp., °F.[c]				
at 264 p.s.i. load	175-210	180[d]	185-210	250
at 66 p.s.i. load	185-230	205[d]	210-230	320
Izod impact, ft.-lb./in. notch				
⅛-in. bar at 23°C.	4.2	8.1	0.6	0.4
⅛-in. bar at 0°C.	1.9	6.2	0.5	[d]
⅛-in. bar at —25°C.	1.1	1.6	0.6	[d]
Charpy, ft.-lb./in. un-notched				
¼-in. bar at 23°C.	17.	24.	4.	[d]
¼-in. bar at —25°C.	20.	26.	5.	[d]

[a]All tests were performed using specimens injection molded at a mold temperature of 149°F. and a stock temperature of 428°F. except Alloy D which requires somewhat higher temperatures. Where applicable, standard ASTM test methods were employed. While the values reported are believed to be representative, since conditions under which molded parts are produced may vary, these values may not necessarily be obtained for all test specimens and parts which may be produced from these alloys.

[b]Specimen did not break.

[c]Specimens were not annealed prior to testing. Two types of Alloys A, B, and C are available, one type having the lower of the two values and the other type the higher value stated for heat distortion temperature.

[d]Data not presently available.

fluorocarbon; in 3 min. the silicone alloy is more than 30 times as effective. The basic data were obtained by the Submarine Antenna Branch of the Underwater Sound Laboratory. The test specimens were sections of rod stock about 2 in. in diameter. They were mounted in a rack attached to the deck rail of an active fleet submarine and exposed continuously to the elements for 26 weeks. They were then removed from the rack, cleaned thoroughly with an aerosol, and sanded. The specimens were then replaced in the rack and exposed for another 11 weeks. The surface resistivities of the dirt-encrusted specimens were measured at a high frequency after they had been "conditioned" further by soaking them in sea water.

The characteristically stable electrical properties of a silicone alloy, illustrated in Fig. 2, p. 210, were determined from specimens exposed continuously to the elements for 12 mo. in a semi-industrial location adjacent to the Delaware River at Wilmington. The specimens, in the form of sheets ⅛ and ½ in. thick, were made by compression molding at 390°F. and 1900 p.s.i. and cooled in the mold. They were exposed to the elements at an angle of 45°, facing south. Except on weekends, the specimens were sprayed daily with a salt solution in the late afternoon, and then with clear tap water early the next morning.

Like all of the alloys used to produce the insulators, bushings, rod stock, antenna domes, and lenses mentioned here, the alloy contained no anti-oxidant, ultraviolet-light absorber, or pigment; its stable properties and freedom from stress-cracking and crazing are due to the silicone. Physical properties over the 12-mo. period corresponding to the electrical properties already illustrated (Fig. 2) are shown in Fig. 4, p. 212. Maintenance of impact strength as determined on test pieces with machined notches, the hardness curve, and the other data serve to confirm the stability indicated by the perhaps more sensitive electrical tests. Particles of embedded dirt and old scratches filled with dirt, could be observed readily on the exposed pieces. But there were no signs of cracking or crazing.

Two other test results obtained by the Underwater Sound Laboratory for silicone-alloy insulators (Fig. 1, p. 210), may be cited to illustrate the thermal shock resistance and the strength of the alloy.

In the thermal shock test, the

Table II: Electrical properties[a]

Property		Alloy A	Alloy B	Alloy C	Alloy D
Dielectric constant	1 mc.	2.57	2.54	2.54	2.93
	100 mc.	2.55	2.52	2.54	2.84
	9375 mc.	2.52	2.51	2.52	2.66
Loss tangent	1 mc.	0.0013	0.0018	0.0003	0.009
	100 mc.	0.0030	0.0060	0.0026	0.018
	9375 mc.	0.0020	0.0021	0.0008	0.011
Short-time dielectric strength, v./mil, 1/10-in. thick		667	607	825+	578
Surface resistivity, ohms $\times 10^{14}$					
at 50% relative humidity		>2	>2	>2	>2
at 95% relative humidity		2	>2	>2	>2
Volume resistivity, ohm-cm. $\times 10^{15}$					
at 50% relative humidity		>1.3	1.5	>1.5	>1.5
at 95% relative humidity		>1.3	1.5	>1.5	>1.5

[a]See note a, Table I.

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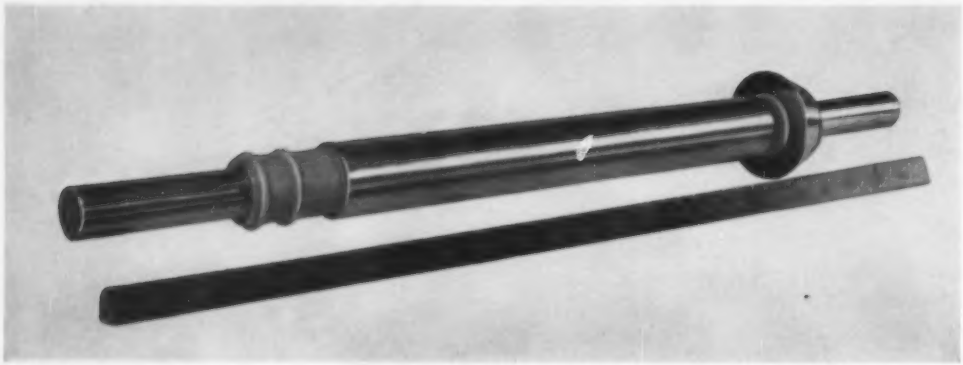

Fig. 1: USN-USL whip-antenna support insulator

insulator was cycled between a chamber maintained at −18° F. and one maintained at 149° F., being held in each chamber for 3-hr. periods. The alloy did not show any sign of cracking or of crazing, nor did it separate from a 1-in. diameter molded-in stud.

In the second test, the insulator was mounted in a torque-testing set-up having a capacity of 200 foot-pounds. This device did not have sufficient capacity to turn the stud in the alloy; the assembly did not break. By way of comparison, the machine broke a ½-in. diameter steel cap-screw at a torque of 85 foot-pounds!

Some heavy moldings

Another interesting application of a silicone alloy is a large dome (Fig. 5, p. 214) having wall thicknesses varying more than eight-fold in a completed molding having a gross weight of about 60 pounds. This dome, in two sizes, was designed by the Underwater Sound Laboratory to house multiband, omni-directional microwave antennas. Mounted outboard on a submarine, the dome has a dual responsibility: 1) to protect the electronic system against external forces and infiltration of sea water even when submerged to great depths and when subjected to severe shock stresses, and, 2) to provide for proper transmission at different microwave frequencies for the full 360° of azimuth. The dielectric material must remain dimensionally stable, when subjected to combined temperature and pressure cycling, if the seal at the clamping ring is to be maintained. There must be no plastic flow of material between points in the dome itself. There must be no displacement of any part of the dome wall toward the precision antenna. The molded material of course must be free of voids, a tough requirement in a section so variable and thick: even pinhead-size voids will cause reflections of the electromagnetic beam at the air-dielectric interface as it passes through the material. The molded compound also must be capable of being machined to close tolerances, without destroying its surface properties, in order that the required wall thicknesses may be obtained economically.

The larger-size dome is molded in two parts for assembly into a truncated cone which required the minimum possible amount of molding compound and served as a blank from which the dome may be machined. The blanks for the domes were molded by the Taunton Plant of General Electric Co., using positive compression on the moldings. The mold for the upper portion of the larger dome was designed so that the smaller, one-piece dome could also be machined from the same molded blank. Thus, mold cost was held to a reasonable amount. The two parts of the larger dome were assembled to provide a stable, water-tight joint around the dome, and were machined to contour by Delaware Research, which also machined the smaller one-piece dome.

The silicone-alloy domes have been found to faithfully transmit the required beam patterns, to maintain their dielectric properties, to remain completely dimensionally stable when exposed to temperature cycles from

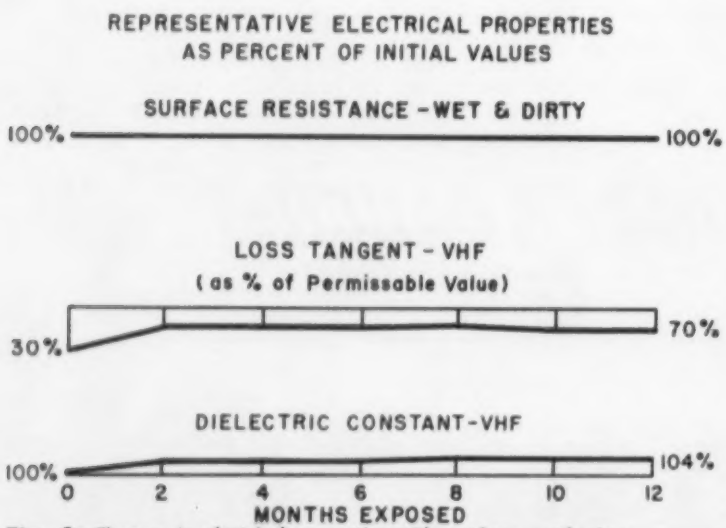

Fig. 2: Changes in electrical properties with outdoor weathering

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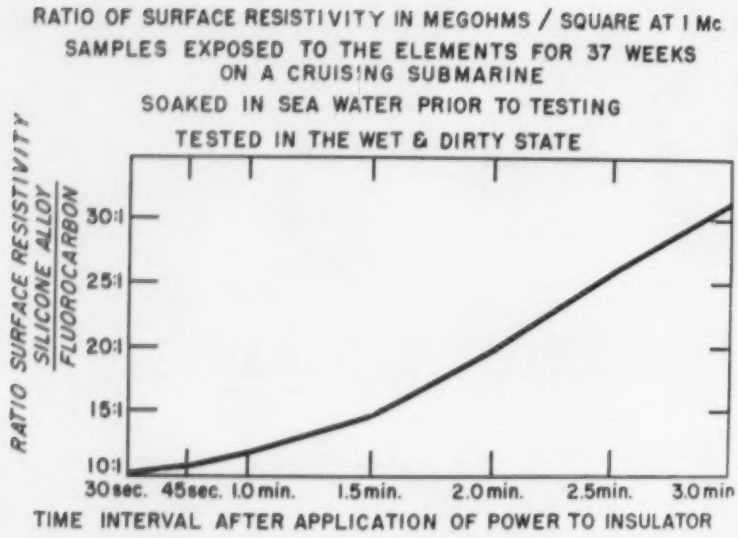

Fig. 3: Comparative recovery, silicone alloy *vs.* fluorocarbon

—40° F. to 150° F. and to pressures cycled between atmospheric and 500 p.s.i. hydrostatic.

A silicone-alloy dome in service on a modern submarine since March 1955 has provided complete protection for the antenna. There has been no leakage of sea water into the system and the alloy shows no evidence of cracking or crazing. The surface is reported to have the same characteristics it had when new. Above all, the antenna is reported to have performed flawlessly and to have required no maintenance or repair. Another dome in use at a Navy shore installation in New London, Conn., since the summer of 1955 has been equally good.

The attribute of dimensional stability under continued stress caused the Wind Turbine Co., West Chester, Pa., to produce silicone-alloy strain insulators for broad-band curtain antennas for use in the Arctic. Rod stock was machined to the appropriate contour and the holding eyes and end shields mechanically clamped in place. Here again, in addition to dimensional stability, surface resistance must be maintained for long periods of outdoor exposure without cleaning. A typical insulator is illustrated in Fig. 6, p. 219. The antenna engineers reported that the silicone-alloy insulator suffered much less ice build-up than the conventional ceramic insulator and, in addition, withstood far better the abuse occasioned when the ice was knocked off.

On occasion, electrical insulating materials may not maintain their surface and volume resistivities under conditions of high humidity and especially after contamination by perspiration upon handling. For example, the mere touching of one insulating material (polystyrene) with the fingers is sufficient to render it useless for some electrical applications. Specimens of the silicone alloy used to produce the microwave antenna domes were deliberately contaminated by handling and then exposed to 50% and 90% relative humidity at 73° F. for 24 hr., with the following results (reported by an organization concerned with radiation-measuring instruments):

	Relative humidity	
Property	*50%*	*90%*
Surface resistivity, 10^{15} ohms	27	14
Volume resistivity, 10^{15} ohm-cm.	3.6	2.8

Another contaminated alloy exhibited a resistivity at 90% relative humidity of 16×10^{16} ohm-centimeters.

A promising field for expanding use of polymer materials is in construction of microwave antenna lenses for radar, relay links, and communications networks. The Microwave Antennas and Components Branch of the Naval Research Laboratory has taken a leading part in encouraging development of dielectric materials for lens construction.

The Branch, about a year ago, designed, had built, and tested a ±20° bifocal lens employing a silicone alloy, which is opaque to visible wavelengths. This work was done in part to determine the acceptability of the alloy as a microwave-antenna lens material, including its homogeneity and isotropy, its capability of being fabricated economically into large, thick sheets, and its ma-

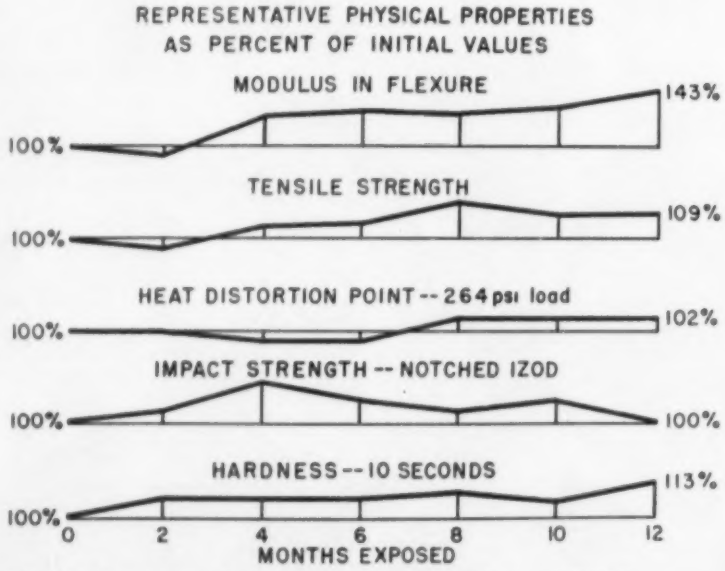

Fig. 4: Changes in physical properties with outdoor weathering

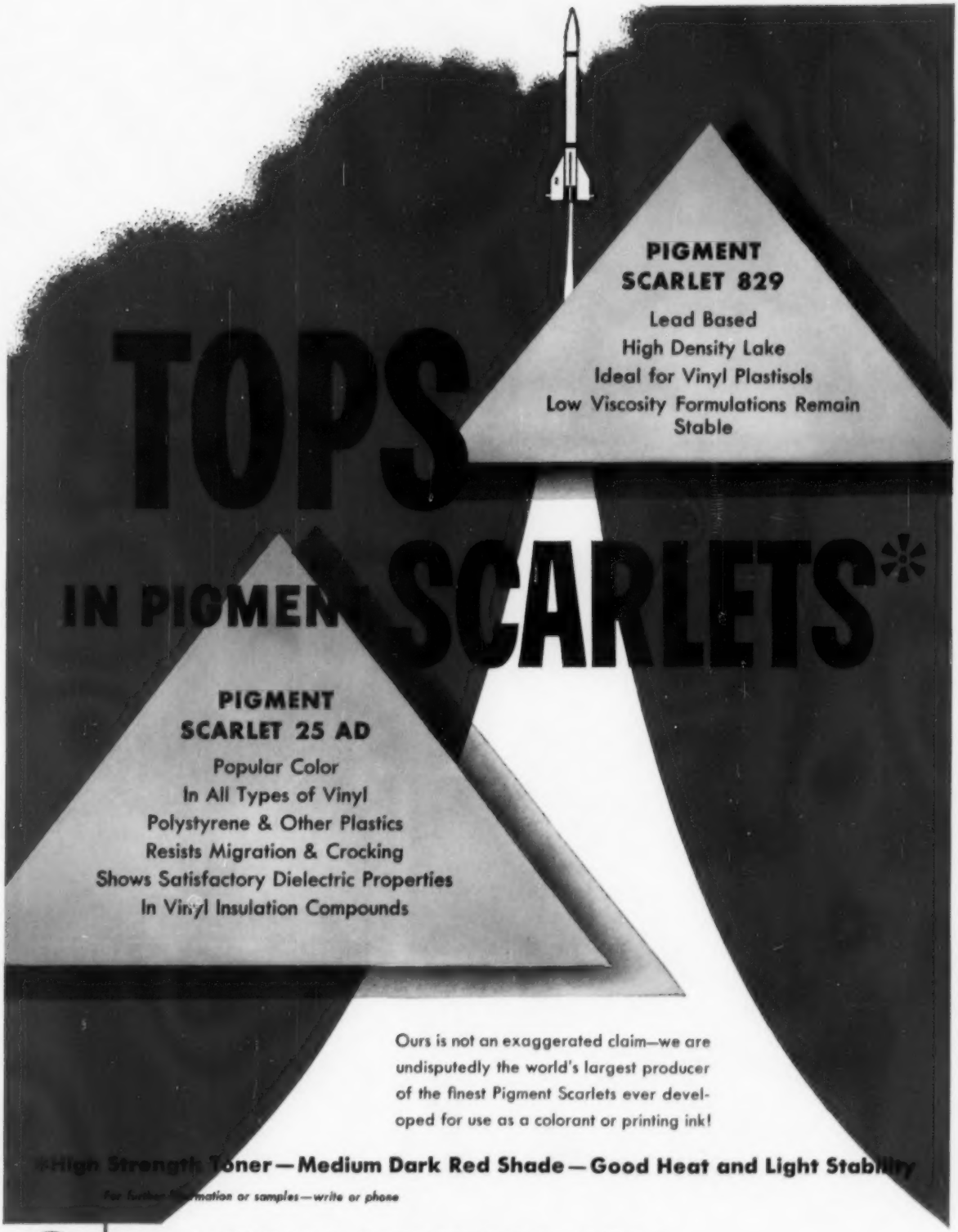

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Fig. 5: USN-USL submarine antenna dome

chinability to the close tolerances required. The effective diameter of this lens is 16 in., the maximum thickness 2.28 in., and the focal length 22.4 in., with both faces machined to differing convex contours. The mounting rim, a part of the lens blank as molded, is 0.75 in. wide and 0.50 in. thick. The finished lens weighs approximately 11 pounds.

A blank, 18 in. square by 2.5 in. thick, was required to produce this lens. In order to determine whether tool cost for molds could be kept down and still permit the production of substantially thicker lenses as well, it was decided to use an ordinary fixed cavity compression-type mold that would produce a slab measuring 18.5 in. square by 1.0 in. thick. Three of these slabs then were welded together. Both weld-lines were exposed peripherally when the 3-in.-thick blank was easily machined to the final varying thickness dimensions. The 3-in. blank was machined using a standard tool-steel milling cutter. No lubricant was needed and light cuts at high speed gave an excellent finish. A stream of air cooled the work and removed chips. Beam pattern determination at 34,900 mc./sec. proved that the material was homogeneous and also isotropic throughout. No phase errors were introduced. It was concluded that the silicone alloy performs very well as a lens material.

Injection molding

An interesting job from the standpoints of both materials and injection molding was to produce fairing sections (Fig. 7, p. 219) measuring about 15 by 8 in. and tapering from a leading edge having a projected width of nearly 1.25 in. to a feathered trailing edge. The finished piece, which weighs nearly 1.3 lb., fits on a stainless steel mast and must remain free to rotate when exposed to all kinds of weather and temperature conditions, including immersion in sea water. Its function is to absorb sudden shock stresses and prevent breaking of the submarine antenna mast. The particular alloy used has the following physical properties:

Flexural strength, p.s.i.	7190
Modulus in flexure, p.s.i. ...	255,000
Izod impact strength, machined notch, ft.-lb./in. ..	6.8
Heat distortion point, 264 p.s.i. load, °F.	190
Hardness, Shore D, 10 sec. ..	70
Specific gravity	1.06

These sections also were molded by G.E. in a 24-oz. injection molding machine, using a single-cavity polished steel mold. The stock temperature was approximately 450° F. and the mold temperature about 175° F. The total cycle time was 80 seconds.

The molded sections were fabricated into the finished fairings by Delaware Research. This part, like those described previously, required exceptionally careful engineering design of the section, the mold, and the fabricating fixtures.

One of the novel properties of the silicone alloys is relatively high uniformity of impact strength throughout a long injection molded length, from the gate to the cold end of the molding. Sheet stock measuring approximately 20 by 6 by ⅛ in., gated at a point near the center of the 6-in. width, had a surprisingly high degree of uniformity of impact strength when sampled at nine locations in the sheet. It is believed that the silicone protects the alloy, perhaps by a form of lubrication, against internal stress during molding.

Extrusions

The hydrophobic nature of the silicone alloys is, of course, a prime reason for their durability and stability in exposed electrical and mechanical applications and it also seems to contribute protection against other degrading influences. Thus, a prominent manufacturer of home appliances, when evaluating a white alloy for refrigerator and freezer breaker-strip uses, described the material as having a pleasing hand, good mar and spot resistance, and freedom from odor. This company also stated that the alloy is not degraded by plasticizer extraction from a flexible vinyl gasket with which it is in forcible contact. They added the following characterizations: a) Dimensional stability: far superior to ethyl cellulose and better than

(*To page* 219)

Pump parts on this beverage jug are molded from BAKELITE Brand C-11 Plastic. Details are on next page.

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(continued on next page)

(continued from preceding page)

C-11 parts are colorful, tough, resistant to staining

The pump unit on the insulated jug, except for the bulb, is made of BAKELITE Brand C-11 Plastic. The unit consists of red spout, beige threaded ring, and black pump body. These sections are bonded together to form an integral unit. The resistance of C-11 to citrus oils, alcohol, hot tea, and coffee is one reason for its use. Another factor is the toughness of C-11; the pump unit is handled frequently, and must be removed when the jug is filled or washed. The tube is a flexible extrusion of BAKELITE Brand Polyethylene.

BAKELITE C-11 Plastic is an acrylonitrile-styrene copolymer with excellent mechanical strength and chemical resistance. Wide color possibilities and a high degree of clarity make it useful for a variety of eye-catching products.

"Skotch O'Matic" jug pump parts molded by **Campro Company**, Canton, Ohio, for **Hamilton Metal Products Co.**, Hamilton, Ohio.

"Boco" tile clips molded by **Mayfair Plastics, Inc.**, Detroit 2, Mich., for **Boco Industries, Inc.**, Detroit 19, Mich.

Polyethylene's durability meets the field tile test

This joint-covering device molded of BAKELITE Brand Polyethylene keeps stones and soil from working between field tile sections and clogging sewage disposal systems. These tile clips are strong, tough, and resistant to disintegration by moisture, acids, and alkalies in the ground. In addition, they aid in spacing the tiles. Each clip has lugs integrally molded on its underside to assure the exact ⅝-in. separation needed to permit tile expansion while preventing entry of soil and stones. A fin molded into the top serves as a handle and guide to proper alignment. The clip covers only the top and sides of the joint, leaving the bottom open for dispersal of liquids.

This is an example of the toughness and chemical resistance of BAKELITE Polyethylene. Some of the more decorative applications of this material, such as kitchenware and squeeze bottles, make use of its color range and fine molding details.

BMG-5000 black phenolic provides superior finish for TV remote control handle

The high gloss on this TV remote control handle gives an indication of the molding results you can obtain with a general-purpose phenolic—BAKELITE Brand Phenolic BMG-5000 Black 25. The handle serves also as a housing designed to hold the remote control working parts.

BMG-5000 is noted for its rapid cure rate, which results in greater press and mold utilization and increased production. The wide molding latitude of this material permits it to be preheated to a higher temperature and consequently molded on shorter cycles without danger of incomplete mold fill-out.

Handle for remote control on **Admiral** Television molded by **Molded Products Corp.**, Chicago 24, Ill.

This impact styrene speeds production of a product built for speed

These plates molded of BAKELITE Brand High-Impact Styrene TMD-5151 can increase swimming speed 25 per cent, reports the manufacturer. Their functional design is reflected in cleanly-molded lines, smooth surfaces. Their light weight minimizes swimming fatigue. Their impact strength equips them for rough treatment on beach, boat, or ocean floor. Salt water won't affect them. A choice of colors makes them eye-catchers.

Speed in production is another advantage derived from TMD-5151; its inherently high plasticity results in the fastest setup available in a high-impact styrene. Impact strength is more than eight times that of general-purpose styrenes.*

*ASTM average Izod test values using notched ¼ in. bar at 74 deg. F.

Brit "Swim Saucers" molded by the **Brittain Products Co.**, Cuyahoga Falls, Ohio.

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high-impact styrene. b) Acceptable finish and acceptable color stability after 100 hr. at 158° F. under an ultra-violet lamp and after heat aging for seven days at 158° F. in a mechanical convection oven. c) Impact strength: superior to impact styrene and at least equal to ethyl cellulose, in both the new condition and after heat aging as above. d) Flex fatigue: superior to impact styrene and at least equal to ethyl cellulose, both new and after heat aging as above. e) Installation fatigue: substantially superior to impact styrene and at least equal to ethyl cellulose.

Also reported was an appreciable saving over ethyl cellulose in cost per foot of finished breaker strip.

Industrial Plastics Corp., Elkhart, Ind., extruded this experimental breaker strip as well as the refrigerator pan-seal channel, both illustrated in Fig. 8, p. 223. The company had had no previous experience with the silicone alloys and the only die available for the breaker strip was an unplated die designed for regular polyethylene. They reported that the material extruded beautifully at acceptable, competitive production rates. The temperature of the extruded die could wander by 75° F. or more without affecting the extrudibility, surface finish, or dimensional conformance of the material to the profile of the strip. They also reported that the material ran smoothly, without sticking or hang-up in the die, and set up quickly. The extruded material consistently was homogeneous and uniform in appearance as the runs continued. There were no "fish-eyes." Regranulated material was found to run equally as well as virgin alloy. The pan-seal channel, produced with a die designed for ethyl cellulose, was reported to run just as well.

The extruder used for both parts was a 2½-in. NRM oil-heated machine with electrically heated head and die and a single-flight screw with torpedo. Extrusion conditions were:

Hopper drier	300° F.
Feed section	Cooled with cold water
Back cylinder	340° F.
Middle cylinder	360° F.
Front cylinder	370° F.
Head	375° F.
Die	380° F.
Screen pack	20/40/60 mesh

The extruded strip was cooled with air, with a section only 12 in. long exposed to forced-air. Take-off rolls were not used.

Fig. 6: New type of low-loss silicone alloy WR (water repellent) insulator with corona shield and bells for radio-frequency circuits. WR-14 specifications: length (C to C holes)—18¼ in.; length insulation—14 in.; working load—600 lb.; weight—2¼ pounds

Good vacuum forming material

One user extruded sheeting that he subsequently vacuum formed. Sheets were extruded in four thicknesses from 60 to 200 mils, and were reported to have such a high gloss that a film overlay, needed on this job when other materials were used, was not needed with the silicone alloy. It flowed well during forming of sharp-cornered trays with strong corners.

Processing

A significant feature of the silicone alloys is the fact that identically the same compound has been molded and extruded with equally acceptable results. It is unnecessary to inventory two slightly different grades of essentially the same compound in order to utilize these two processing techniques. The compound used to produce the extruded rod and tube stocks of Fig. 9, p. 223, has also been molded into telephone-handset bases, tool handles, television-tube caps, and other parts. It is not necessary to use a transparent overlay to obtain an acceptable surface finish on extrusions. The same compound may be molded by injection, compression, or transfer.

Thanks to the inherent lubricity and anti-stick properties of silicone alloys, and to their easy flow, they are easily vacuum-formed.

The coated wire also shown in

(*To page* 223)

Fig. 7: USN-USL fairing for an antenna mast

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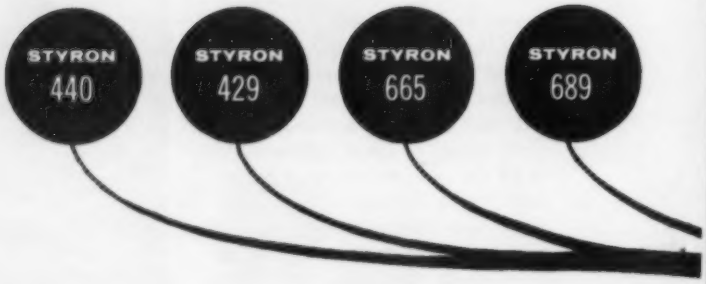

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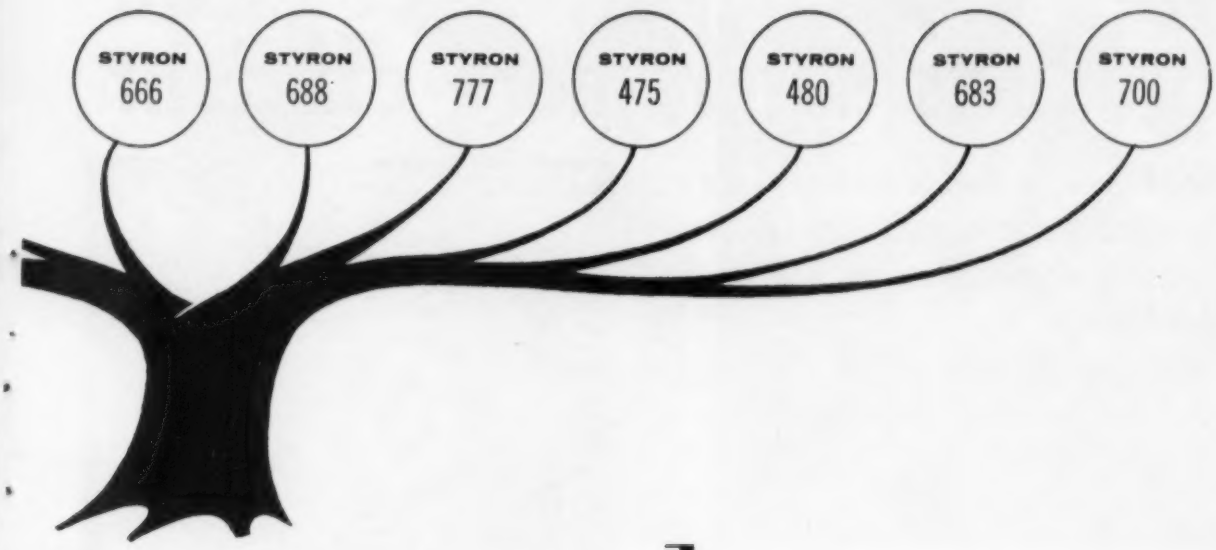

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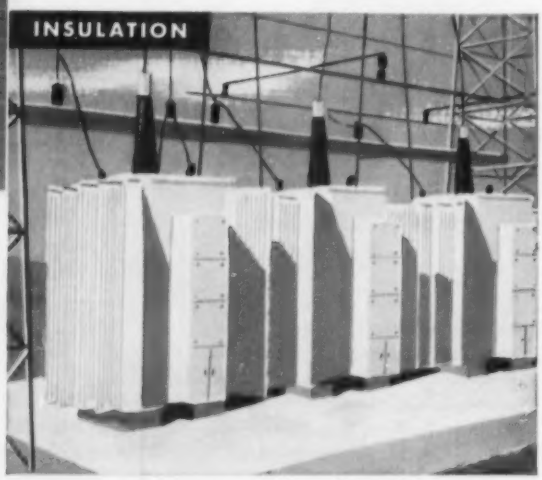

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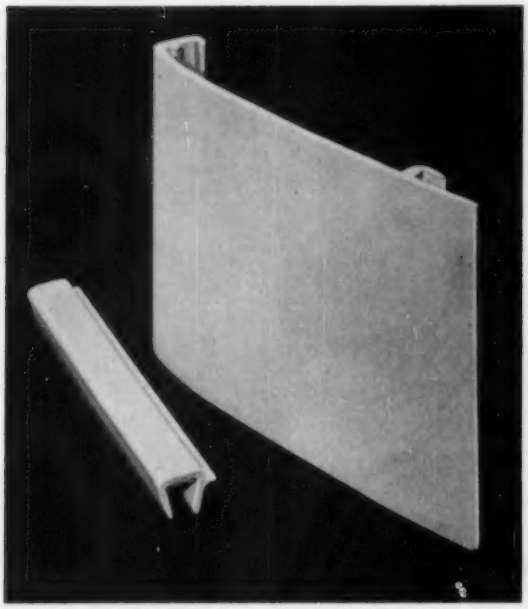

Fig. 8: Extruded breaker strip and pan seal channel

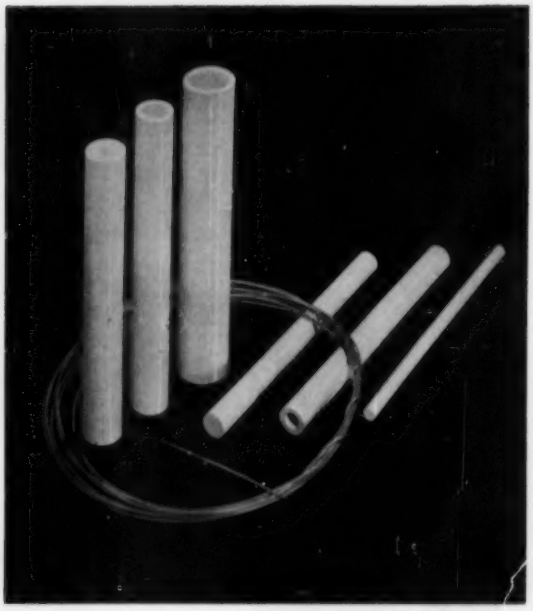

Fig. 9: Extruded rods and tubes, insulated wire

Fig. 9 utilizes the special high-temperature alloy on which data are given in Tables I and II. An 8-mil coating was extruded in a single pass on 20-gage copper wire using a cross-head die. This alloy, upon working, undergoes orientation and may be stretched. When this coated wire is flexed, the copper breaks first; the coating tears only after considerable extension.

As in the cases of the other extrusions illustrated, for which alloys of medium and relatively high-impact strength were used, the wire-coating operation was also found to be insensitive to temperature, with a permissible range of 100° F. The alloy set up quickly on the wire as it emerged from the die. This same compound has been used to injection mold large lattice-section protective grids for high-voltage equipment where good knitting (welding), toughness, good dielectric strength in relatively thick sections, and self-extinguishing properties are required. Molded Insulation Co., Philadelphia, has used this alloy to injection mold extremely close-tolerance electrical connectors having metal inserts, for which outstanding dimensional stability under conditions of elevated temperature and 100% relative humidity is essential to proper performance of the electrical circuit.

Vulcanized Rubber & Plastics Co., Morrisville, Pa., is injection molding industrial machine parts and metering equipment, as well as electrical fittings, some heretofore made of sulfur-hardened rubber. Toughness, dimensional stability, low water absorption, isotropy, and homogeneity again are needed, in several cases for applications where metals have been used.

With the exception of the high-temperature alloy which requires somewhat greater molding temperatures, the alloys described in Tables I and II are reported to injection mold well at stock temperatures from 350 to 425° F. and mold temperatures of 150 to 175° F. Flow in the injection mold and mold release appear to be facilitated. It has been reported that greater utilization of machine capacity can be obtained with these new compounds. These characteristics could have been predicted from the composition of alloys.

Finally, and although it may seem anomalous, it is practical to bond the silicone alloys to steel and to non-ferrous metals, to themselves and to other polymers, using techniques developed especially for them. They have been incorporated as windows and stops, often machined to unusual shapes, in metal wave guides. One electronics company reported that there was no leakage of hydrogen in a guide containing a tapered stop pressurized at 238 p.s.i.

On the basis of the results obtained to date with various molded and extruded products, some of which have been used under very severe conditions, the silicone alloys have a significant place as engineering materials.

Acknowledgements

It is a pleasure to acknowledge the contributions to the development of the silicone alloys made by Kenneth L. Blaisdell, Cletus M. Dunn, and Robert W. Turner of the U. S. Navy Underwater Sound Laboratory; Drs. John I. Bohnert and Arthur E. Marston of the Naval Research Laboratory; George D. M. Peeler, now of Raytheon Mfg. Co.; Lee J. Swift of Industrial Plastics Corp.; Robert W. Weeks and Peter G. Park of Wind Turbine Co.; William R. Heineman, Emil J. Kleiner, and Harold M. Patterson of General Electric Co.; Willard R. Barrett and my associates at Delaware Research, in particular Thomas J. Dietz, the inventor of the alloys.

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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Metal-bonding adhesives for high-temperature service

By John M. Black† and R. F. Blomquist†

The results of an investigation made for the purpose of developing a metal-bonding adhesive with improved heat-resistant properties are reported. The most promising results were obtained with a formulation of a phenol resin and an epoxy resin with certain heat stabilizers and catalysts. The formulation has high resistance to aging at 550° F. and is particularly promising in tape form for bonding sandwich constructions. An improved straight epoxy adhesive that has superior strength properties at 250 to 300° F. compared with any other known epoxy adhesive formulation is also reported.

This report presents the results of another phase of an investigation of experimental adhesive formulations with improved performance and heat-resistant properties for structural bonding of metal to metal in aircraft fabrication. Particular attention has been given to the development of adhesives of phenol and epoxy resins that are less sensitive to variations in bonding techniques and that have better strength in joints over the temperature range of from −70 to 600° F.

Adhesive FPL-710 (1)[1] developed promising shear strength when tested at temperatures up to 600° F. and possessed good resistance to aging at temperatures as high as 450° F. Its principal limitations were that it was somewhat brittle, possessed marginal bending and fatigue strength and variable performance at 600° F., and that the optimum film thickness for bonding —0.002 in.—was too thin for practical use in aircraft. Its variable performance in immediate tests at 600° F. was improved by postcuring the adhesive and by impregnating it into a glass-mat carrier to form a tape adhesive (2). The tape adhesive increased the optimum film thickness for bonding to 0.010 in., which made it more practical in industrial bonding applications. The resistance of adhesive FPL-710 to aging at 550° F. was also improved by the addition of certain chelating agents to the adhesive mixture. The tape adhesive, however, was still quite brittle, had low resistance to peel, was somewhat variable in its performance after aging at 550° F., and lacked adequate flow and filleting action. For these reasons it was not completely satisfactory for the bonding of honeycomb sandwich construction.

The present report includes additional work on FPL-710 adhesive and covers the development of FPL-878 liquid and tape adhesives and FPL-881, an epoxy adhesive. The FPL-878 adhesives are considered improvements over FPL-710 adhesive in many respects and are particularly promising in tape form for such applications as the bonding of heat-resistant materials for sandwich construction.

Preparation of metal

The aluminum surfaces were prepared for bonding by immersion for 5 to 10 min. in a solution of sulfuric acid (10 g.) and sodium dichromate (1 g.) in 30 g. of water at 140 to 160° F. Following this preparation, the panels were rinsed in cold running water, then in hot water or steam, and then were air-dried.

The stainless-steel surfaces

*Reg. U.S. Pat. Off.

Based on Research Memorandum RM 55F08 of the National Advisory Committee for Aeronautics.

†Forest Products Laboratory, Madison, Wis.

[1]Numbers in parentheses link to references at end of article, p. 236.

were cleaned by the following methods:

1. A 10-min. immersion at 190° F. in the following solution:

Material	*Parts by wt.*
Sodium metasilicate	21
Tetra sodium pyrophosphate	11
Sodium hydroxide	11
Nacconol NR (wetting agent)	3.5
Water	910

The panels were rinsed in cold water, then in hot water or steam, and then were air-dried.

2. Cleaning by method 1 followed by a 10-min. immersion at 190° F. in a solution of the following composition.

Material	*Parts by wt.*
Oxalic acid	10
Sulfuric acid (sp. gr. 1.84)	10
Water	80

The panels were rinsed in cold water, then in hot water or steam, and then were air-dried.

3. Cleaning by method 1 followed by a 10-min. immersion at 190° F. in the following solution:

Material	*Parts by vol.*
Hydrofluoric acid (48%)	15
Sulfuric acid (sp. gr. 1.84)	10
Water	25

The panels were rinsed in cold water, then in hot water or steam, and then were air-dried.

Test methods

Specimens of 0.064-in. 2024-T3 (24S-T3) clad aluminum alloy with 0.5-in. overlap were used for the evaluation of bending strength and shear strength (3). Two lap panels, each 8 in. wide, were bonded for each variable. Each panel was then cut into seven individual test specimens, and the 14 specimens per variable were then divided into three representative groups. One group of five specimens was tested as a control group at room temperature, another group of five specimens was aged for 200 hr. at 550° F. and then tested at room temperature, and the final group of four specimens was tested immediately after reaching equilibrium at 600° F.

Lap shear specimens were loaded in self-aligning grips at a rate of 300 lb. /0.5 sq. in./min.[2]; specimens for the bending tests were loaded flatwise at the center as a simple beam with a 1.5-in. span at the rate of 200 lb./min. (3). The loading block was over the center of the bonded area.

[2] This is the slower rate prescribed in reference (4), which preceded reference (3).

Table I: Effect of chelating agents on shear strength of FPL-710 adhesive

Chelating agent	*Shear strength at 80° F. after 200 hr. at 550° F.*
	p.s.i.
None	670
8-Quinolinol	960
Copper 8-quinolinol	298
n-Propyl gallate	1074
Gallic acid	820
1-Hydroxy-2-naphthoic acid	486
3-Hydroxy-2-naphthoic acid	414
5-Phenyl salicylic acid	320
Salicylic acid	890
Salicylaldehyde	785
Acetyl-acetone	985
Acetonyl-acetone	965
Aluminum triacetonyl-acetonate	960
Catechol	980
o-Amino-phenol	320
Ethylenediamine	835
Oxalic acid	120
Mucic acid	480
Tartaric acid	320
Copper citrate	480
Triethanolamine titanate	440

Test temperatures were controlled during heat-aging and testing to within ±3° F. of the desired temperature. In tests at elevated temperatures, a period of 3 to 5 min. was required to heat the specimens from room temperature to the test temperatures. In tests made at elevated temperatures and at —70° F., the load was applied as soon as the specimen reached the desired temperature.

For the peel test, sandwich specimens (3 by 12 in.) of 0.020-in. clad 2024-T3 aluminum faces bonded to ½ in. thick aluminum honeycomb cores (3/16-in. cell, 0.002-in. foil) were tested by peeling over an experimental peel-test apparatus with a 4-in.-diameter drum. The peel-test apparatus was equipped with a movable table and tension spring to maintain movement of the test specimens at the same rate as peeling. A peeling rate of approximately 12 in./min. was used, and an autographic recording was made of load versus distance peeled.

FPL-710 adhesive

Resistance to aging

The effect of several different chelating agents on the resistance of FPL-710 adhesive to aging for 200 hr. at 550° F. was previously reported (2). The data indicated that a few of the chelating agents were effective in improving the resistance of the bonds to heat-aging. It was thought that the agents reduced the activity of trace elements, such as copper and iron in the clad-aluminum surface, which could be contributing to the oxidation and deterioration of the adhesive during the heat-aging process.

This phase of the study was continued and other chelating agents were investigated. In a study of FPL-710 adhesive in methyl ethyl ketone, a quantity of 1% chelating agent, based on the weight of the resin solids of adhesive, was employed, and joints were tested at 80° F. after aging for 200 hr. at 550° F. The results of these tests are shown in Table I, left.

Several of the chelate stabilizers were promising for retarding the degradation of the adhesive on aging at elevated temperatures. The *n*-propyl gallate appeared most effective, but 8-quinolinol, gallic acid, salicylic acid, salicylaldehyde, acetyl-acetone, acetonyl-acetone, aluminum triacetonyl-acetonate, catechol, and ethylenediamine were also quite effective when results were compared with those from the control specimens. Although 8-quinolinol was an effective stabilizer, the copper salt of 8-quinolinol was quite ineffective and actually appeared to contribute to the rate of thermal breakdown of the adhesives.

Subsequent bonding with FPL-710 adhesive formulations containing the better chelate stabilizers shows a definite improvement over the control-specimen bonds

in the resistance of the bonds to aging at 550° F. The spread in individual strength values was reduced, but the problem of obtaining consistently high strength bonds remained. In attempting to overcome this limitation, a study was made of many bonding variables and variations in the adhesive formulation. Bonding variables studied included preparation of the metal surface, age of the stock adhesive, age of the thinned adhesive, percentage of hexamethylenetetramine curing agent, time of reflux in preparation of the adhesive, precure and curing conditions, and the type of solvent and thinner employed in the adhesive. The results of these studies showed no definite trend in the reduction of joint-strength variability after heat aging, with the exception of the type of solvent and thinner. In this study toluene, ethyl acetate, and methyl ethyl ketone were employed, and results showed that ethyl acetate solvent and thinner reduced the variability of results to a slight degree. The following formula appeared most promising for this adhesive:

Material	*Wt., g.*
Bakelite BV 9700 (phenol resin)[a]	100
Epon 1007 (epoxy resin)[b]	20
Ethyl acetate	20
Hexamethylenetetramine	4
n-Propyl gallate	0.8

This adhesive formulation was then used for the determination of resistance to salt-spray exposure and for the development of the mat tape.

[a] A product of Bakelite Co., reported to have approximately 60% solids in solution form.
[b] A solid resin produced by Shell Chemical Corp.

Salt-spray exposure

The salt-spray exposure tests of panels bonded with FPL-710 were conducted in accordance with reference (3). The results of salt-spray exposure tests are presented in Table II, below. They showed that the FPL-710 adhesive bonds had high resistance to salt-spray exposure and exceeded in shear strength the 2000 p.s.i. required in ref. 3.

Tape adhesive

Preliminary tests reported previously indicated that bonds made with FPL-710 adhesive impregnated into glass cloth to form a supported tape adhesive resulted in improved shear strength of lap joints when tested immediately at elevated temperatures, such as 600° F.

The tape adhesive was also found to be more satisfactory for bonding metal faces to honeycomb core material than the liquid adhesive.

In view of the encouraging results of these preliminary tests, work on methods of making the tape more uniform and freer of volatiles was continued. Various impregnation methods by dipping and spraying were tried in addition to solvent-casting of the adhesive onto the mat on sheets of Teflon.

The principal problems in each case were to remove the solvent from the adhesive film without overcuring the adhesive and to prevent skinning over the film, thus entrapping the solvent and resulting in formation of bubbles. A method of building up the film thickness by multiple thin coats was most promising, but was far too slow and laborious to be practical.

In bonding clad aluminum faces to high-strength phenol resin-impregnated glass-cloth honeycomb cores, it was observed that the adhesive did not flow and fillet adequately about the edges of the honeycomb to develop a bond strength high enough to fail the core in flexural tests. It seemed desirable to improve the flow of resin during cure to overcome this limitation. An adhesive formulation employing phenol resins with a lower molecular weight and softening point should allow the film to remain fluid at the precure temperature and thus more readily permit the loss of volatiles to occur during precuring. Such a formulation would also have a longer flow life during cure, which would be advantageous. Therefore, the development of FPL-710 composition as a tape adhesive was discontinued in order to concentrate research efforts on such a combination of resins.

Table II: Salt-spray exposure tests of FPL-710 adhesive

Panel[a]	*Shear strength after exposure*[b]		*Type of failure*[c]	
	Average	*Range*	*Adhesion*	*Cohesion*
	p.s.i.	*p.s.i.*	*%*	*%*
1	2771	2665 to 2970	100	0
2	2951	2845 to 3065	99	1
3	2896	2835 to 3005	100	0
4	2860	2700 to 2930	99	1
5	2893	2670 to 3065	100	0
6	2915	2860 to 3005	98	2

[a] Five specimens were exposed and tested from each panel.
[b] Average control strength of this group of panels before exposure was 2440 p.s.i.
[c] Values are estimated averages.

FPL-878 Adhesive

Although the liquid adhesive FPL-710 described previously had excellent strength properties at temperatures up to 600° F. and showed good aging characteristics at 550° F. when used to bond aluminum lap joints, it was unsatisfactory for bonding metal faces to honeycomb cores in sandwich construction and for bonding larger areas in metal laminating because of insufficient film thickness, inadequate flow, and inadequate filleting action of the adhesive during the curing cycle. Effective use of a thicker film of the liquid adhesive to get the desired filleting and flow was limited by the problems arising from additional solvents which would have to be incorporated in a thicker film.

Further work included the investigation of various phenol resins and epoxy resins that could be substituted into the original

Table III: Effect of ratio of resins on shear strength

Durez 16227	Epon 1007	Shear strength at 80° F.	Shear strength at 600° F.
g.	g.	p.s.i.	p.s.i.
100	—	1924	688
100	5	1650	1010
100	10	1706	744
100	20	2090	774
100	25	2100	618
100	30	2236	682
100	40	1884	202

Table IV: Effect of various epoxy resins on shear strength[a]

Epon resin	Shear strength at 80° F.	Shear strength at 600° F.
	p.s.i.	p.s.i.
1009	1460	670
1007	1790	646
1001	1308	452
RN-34	1204	512
RN-48	1302	750

[a]Adhesives were prepared with 100 parts of Durez 16227 and 20 parts of the epoxy resin in ethyl acetate.

FPL-710 formula to improve the flow and the release of solvents during drying of the adhesive. The use of a phenolic resin, Durez 16227 (approximately 80% solids), improved these properties markedly over the original FPL-710 adhesive.

The following discussion of the results is a summary of the most important effects of variations in formulation and bonding procedures in the development of adhesive FPL-878.

Effect of composition

In the initial stages of development, the optimum ratio of phenol resin Durez 16227 to epoxy resin Epon 1007 was determined by dissolving the resins and other components in ethyl acetate to give a solids content of about 70% and applying the liquid adhesive by brush to cleaned clad aluminum-alloy surfaces. Table III, above, shows how the strength of bonds tested at room temperature and immediately at 600° F. was affected by the ratio of the two resins in test formulation for the adhesive.

In a subsequent series of tests the effect of different epoxy resins was evaluated. The results are presented in Table IV.

Based on the results of these tests, a formulation of 100 parts of Durez 16227 and 20 parts of Epon 1007 was selected for further study. The addition of small amounts of hexamethylenetetramine, which was used as curing agent in FPL-710 to increase bond strength at 600° F., was found to be unnecessary in these formulations. In fact, it actually caused a reduction in the shear strength of those bonds tested immediately at 600° F.

In an effort to increase the strength of bonds at 600° F., small amounts of Bakelite BV 9700, a phenol resin that cures faster than Durez 16227, were added to the formulation of Durez 16227 and Epon 1007. The shear strengths of several of these adhesive formulations when tested immediately at 600° F. and the results of these tests are presented in Table V, below.

The addition of increasing amounts of the phenol resin Bakelite BV 9700 to the mixture of Durez 16227 and Epon 1007 resin resulted in an increase in bond strength at 600° F. The strength of the bonds at 80° F., however, was decreased, indicating that the adhesive was made more brittle at normal temperatures. The composition of 100 parts of Durez 16227, 20 parts of Epon 1007, and 20 parts of Bakelite BV 9700, which appeared to be the most promising combination and the best compromise in strength properties, was selected for further study in aging tests. This was the basic formulation of epoxy and phenolic resins from which FPL-878 adhesive was derived.

Table V: Shear strengths of three-component resin adhesives

Durez 16227	Epon 1007	Bakelite BV 9700	Shear strength at 80° F.	Shear strength at 600° F.
g.	g.	g.	p.s.i.	p.s.i.
100	20	—	1790	644
100	20	10	1622	704
100	20	20	1488	930
100	20	30	1442	966

Resistance to aging

A study of the performance of adhesive FPL-878 in clad aluminum lap joints when aged at 550° F. for 200 hr. showed that a considerable loss in shear strength at 800° F. may occur as a result of thermal decomposition or degradation of the adhesive. Tests made before and after aging at this condition show that only 16% of the initial strength (1488 p.s.i.) was retained. The bonds were initially cured at 350° F. for 60 min. after a precure of 45 min. at 270° F.

The addition of 1% of *n*-propyl gallate based on the resin solids of the FPL-878 formulation, which was known to be an effective chelate stabilizer in the FPL-710 adhesive, raised the retention of shear strength under the same conditions to 37 percent.

The addition of certain organic acids, which were also considered as chelating agents, increased the rate of cure and the joint strength of bonds tested immediately at 600° F. The most effective of these acid accelerators was 1-hydroxy-2-naphthoic acid (Table VI, p. 230).

Preparation of FPL-878

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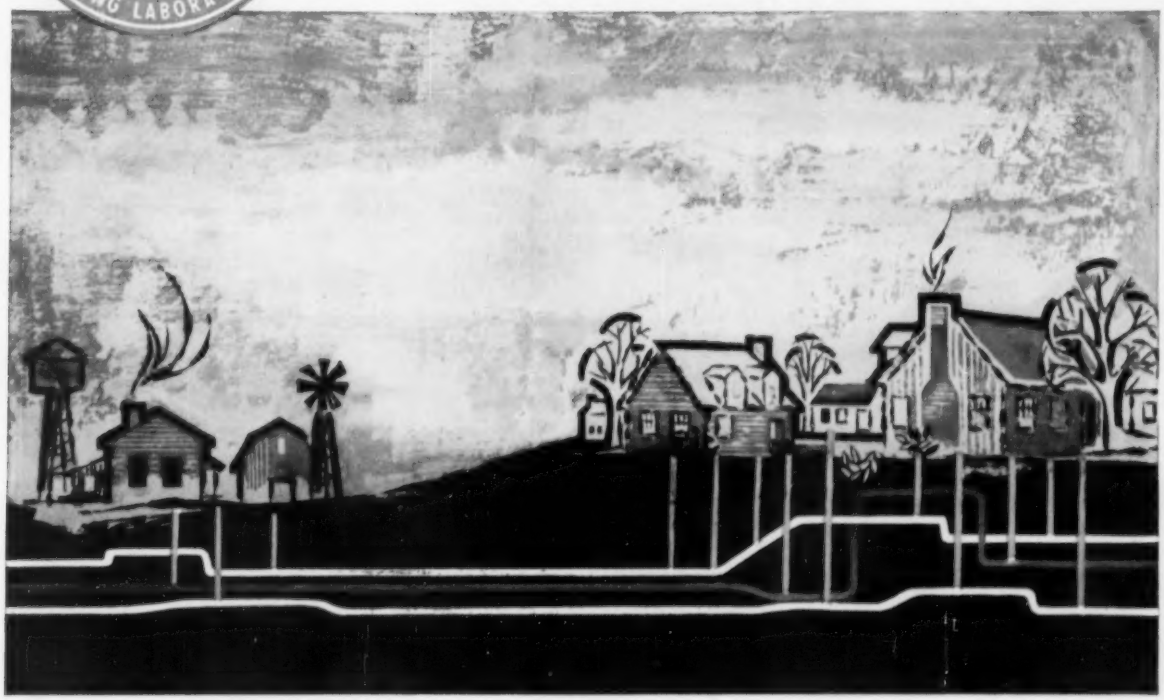

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Table VI: Effect of acid accelerators on shear strength of FPL-878

Acid accelerator	Shear strength[a] Tested immediately at 80° F.	Tested immediately at 600° F.	Tested after aging at 80° F.[b]	Tested after aging at 600° F.[b]
	p.s.i.	p.s.i.	p.s.i.	p.s.i.
None	2243	339	952	302
3-Hydroxy-2-naphthoic (2%)	2350	650	1298	776
1-Hydroxy-2-naphthoic (2%)	2176	894	1376	866
Salicylic (2%)	2450	720	1264	724
5-Phenyl salicylic (2%)	2150	624	1248	764
Benzenesulfonic (1%)	2316	230	1162	636

[a] Lap-joint specimens bonded at 300° F. for 60 min. after a precure of 15 min. at 270° F.
[b] Tested at temperature shown after 200 hr. at 550° F.

ing this investigation, was made up as follows:

Material	Wt., g.
Durez 16227 (phenolic)	125
Bakelite BV 9700 (phenolic)	33
Epon 1007 (epoxy)	20
Ethyl acetate	20
1-Hydroxy-2-naphthoic acid	2.8
n-Propyl gallate	1.4

The adhesive is prepared by dissolving the Epon 1007 resin in the ethyl acetate, to which the remaining components may be added and readily dissolved by warming and thorough mixing. Storage in a closed container at room temperature for a period as long as three months has produced no adverse effect either on the use conditions or on the quality of joints made after storage. The approximate solids content of the adhesive is 78 percent.

Bonding procedure

The following steps in bonding procedure are recommended for consistent results with FPL-878:

1. Prepare the metal surfaces for bonding by an effective chemical cleaning method. For bonding aluminum, an immersion in a solution of sulfuric acid and sodium dichromate is recommended. For bonding stainless steel, immersion in a solution of sulfuric acid and oxalic acid appears most effective.

2. Thin 10 parts by weight of the adhesive with 10 parts by weight of ethyl acetate. The thinned solution has been used for 2 months without adverse effects. Apply one brush coat to each surface to be bonded. Application by spray or roller has not been studied.

3. Precure the adhesive film for 15 min. at 270° F.

4. Assemble the parts to be bonded and press at 320° F. for 1 hour. For optimum strength properties at elevated temperatures, the bond should be postcured for 16 hr. at 270° F. Minimum curing and postcuring requirements have not been established.

Tape adhesive

The more desirable features of adhesive FPL-878 as compared with FPL-710, such as greater film thickness, greater ease in solvent removal, and improved flow properties, made FPL-878 particularly promising for further study and development into a supported tape adhesive. The development of a tape adhesive was considered to be of special importance since it would make the adhesive more practical and easier to use, both in the laminating of metal and also in the bonding of various face materials to honeycomb cores in sandwich construction.

Since no facilities were available for making unsupported films, preliminary investigations of various glass fiber cloths and mats for carriers for supported films were undertaken. The best material appeared to be a glass fiber mat that was approximately 0.010 in. thick and weighed 0.0071 lb./sq. ft. (Owens-Corning Fiberglas Mat S11L). The mat material as a carrier seemed to have better blotting and holding properties than did available cloths, and its use made possible an adhesive tape with greater resin solids per unit area. The cost of the glass mat, approximately 1¢/sq. ft., was also considerably less than that of the glass fiber cloth.

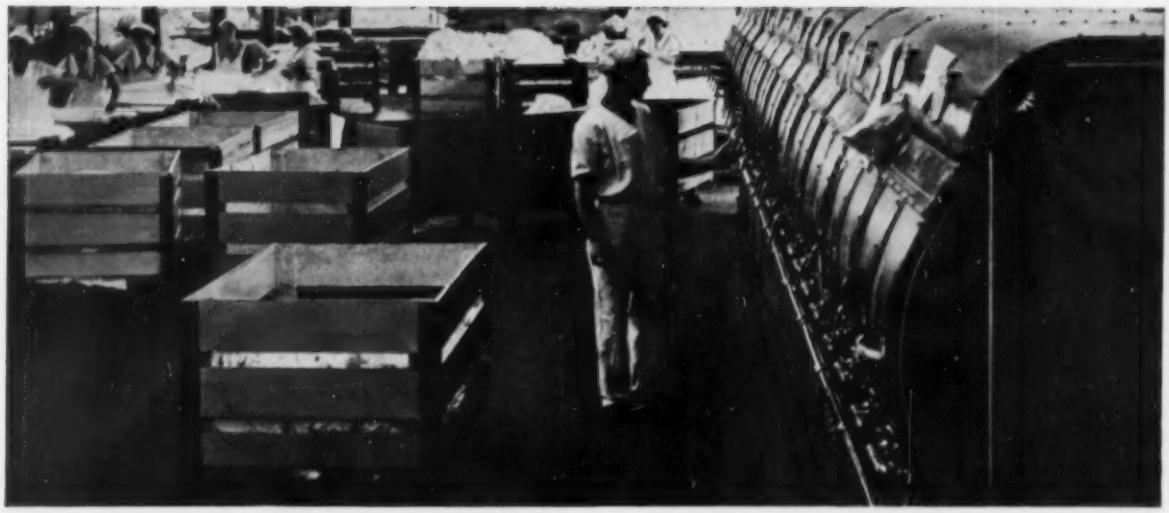
The mat tape adhesive is prepared by impregnating the FPL-878 liquid adhesive (not thinned) into a glass fiber mat or cloth by a solvent-casting method on Teflon film. In this process, the Teflon film is laid on a flat surface, and about one-half the required amount of unthinned liquid adhesive is spread out evenly over the area. The glass mat or cloth is than laid on top of this and worked down through the liquid adhesive. The remainder of the liquid adhesive is then applied to the glass fabric surface and rolled out evenly with hard-rubber hand rollers. The whole assembly is precured at 270° F. for 35 minutes. Immediately after removal from the precuring chamber, the hot liquid-adhesive surface is covered with another film of Teflon, and the film is rolled with hand rollers to force out entrapped air and volatile vapors. After cooling, the Teflon sheets are stripped from the adhesive film and the adhesive tape, which is relatively tack-free, is ready for use. The film should be stored between sheets of polyethylene film to prevent the sticking of adjacent film layers on the tape adhesive. The optimum amounts of adhesive impregnation have not been fully established, but an amount to give about 0.10 to 0.15 lb. of solids per sq. ft. of tape appears to be necessary to develop the strength of certain high-strength honeycomb cores used in sandwich construction.

The FPL-878 tape may be used under the same bonding conditions as described for the liquid adhesive. In bonding of large areas of laminated metal or sand-

(To page 235)

Table VII: Shear strength of sandwich constructions bonded with FPL-878 tape adhesive

Test temp. ° F.	Computed shear stress in core p.s.i.
80	660 (bond failure)
300	560 (bond failure)
500	420 (bond failure)
700	160 (bond failure)



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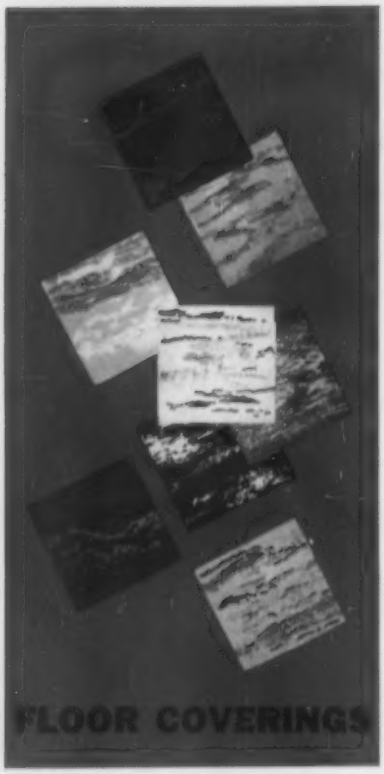

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wich panels, it is recommended that the bonding pressure be released and then restored or the panel breathed three times within the first 6 min. of the curing period. The same postcure of 16 hr. at 270° F. is recommended for the tape as for the liquid adhesive to obtain optimum heat-resistant properties.

Sandwich construction

The FPL-878 tape adhesive has been used to bond sandwich-panel specimens of high-strength, glass cloth honeycomb cores with either clad aluminum or stainless-steel faces in a study to determine the strength properties of the cores in flexural tests at elevated temperatures. The FPL-878 tape adhesive has given consistently higher test results on this type of sandwich specimen at temperatures of 300 to 700° F. than has any other experimental or commercial adhesive tried for this purpose and has facilitated tests, not previously possible, of new high-strength, heat-resistant cores.

Flexural tests of these sandwich specimens have been made at 80, 300, 500, and 700° F., and in some cases actual shear failure of the core was attained. Table VII, p. 230, presents the highest individually computed shear-strength values attained at the various temperatures in a flexural test of clad aluminum faces bonded to high-strength phenolic resin-impregnated glass cloth honeycomb cores.

The average peel strength of 13.7 in.-lb. for an all-aluminum sandwich panel made with FPL-878 tape, as shown in Table VIII, below, is somewhat lower than that of a similar panel made with a commercial phenol-butyral liquid adhesive (which had a strength of approximately 17 in.-lb.) and much lower than that of a panel bonded with phenol-butyral tape adhesive (with a strength of approximately 45 in.-lb.). Neither of these commercial adhesives, however, has significant resistance to heat-aging at 550° F. or resistance to thermal softening at 450 or 600° F.

Strength properties

A summary of the strength properties of aluminum lap joints bonded with FPL-878 liquid and tape adhesives is present in Table VIII. The strength properties of the liquid form of FPL-878 in the various lap-joint tests were generally superior to the tape modification of FPL-878. Both adhesives were outstanding in immediate shear-strength properties at elevated temperatures and in resistance to creep at 300° F. The liquid adhesive was particularly resistant to long-time aging at elevated temperatures, while the tape adhesive showed a very significant loss in strength when aged at a temperature of 450° F. The bend strength and peel strength of both types of adhesives were low and indicative of the brittle characteristics of the adhesives at room temperature. Neither the liquid nor the tape form showed any loss in strength when immersed in hydrocarbon fluid for a period of 7 days.

In the limited number of long-time strength tests, the lap shear specimens were first loaded to 1000 p.s.i. at 300° F. for a period of 200 hr. and then the load was increased to 1500 p.s.i. for an additional 200 hours. There was no creep observed by a periodic microscopic observation of a scratch line on the side of the specimen while under load after the total 400-hr. loading period. Lap joints that were not given the 16-hr. postcure at 270° F., however, failed immediately with the 1000-lb. load applied at 300° F.

FPL-881 Adhesive

Previous comments have indicated that entrapped volatile solvents in liquid-solution adhesives and in film adhesives prepared from such liquid adhesives are

Table VIII: Strength properties of adhesive FPL-878 in various tests

		FPL-878 liquid adhesive				*FPL-878 tape adhesive*			
Test temp.	*Test*[a]	*Control*[b]	*Aged 200 hr. at 350° F.*	*Aged 200 hr. at 450° F.*	*Aged 200 hr. at 550° F.*	*Control*[b]	*Aged 200 hr. at 350° F.*	*Aged 200 hr. at 450° F.*	*Aged 200 hr. at 550° F.*
°F									
—70	Shear strength, p.s.i.	1840	—	—	—	1200	—	—	—
80	Shear strength, p.s.i.	2044	1674	1320	1080	1540	1274	120	0
250	Shear strength, p.s.i.	3134	—	—	—	1634	—	—	—
350	Shear strength, p.s.i.	1336	2310	1162	—	1168	1390	256	—
450	Shear strength, p.s.i.	1298	2078	1322	—	920	1210	124	—
600	Shear strength, p.s.i.	806	958	1156	866	690	860	80	—
80	7-day immersion in hydrocarbon fluid, p.s.i.	2028	1704[c]	—	—	1518	1264[c]	—	—
300	Long-time strength, p.s.i.	1500	—	—	—	1500	—	—	—
80	Bend, lb.	110	—	—	—	87	—	—	—
76	Peel, in.-lb.	—	—	—	—	13.7	—	—	—

[a] All tests except peel tests were made on lap shear specimens of 0.064-in. clad 2024-T3 aluminum alloy with a 0.5-in. lap joint. Tests were conducted in accordance with reference 4. Each value is average of at least five test specimens except long-time strength values which are averages of two specimens, and peel test values which are averages for four specimens.

[b] All specimens were cured for 60 min. at 320° F. Control specimens only were postcured for 16 hr. at 270° F.

[c] Specimens were aged for 200 hr. at 350° F. before immersion.

Table IX: Effect of epoxide-amine ratio on shear strength

Amount of amine[a]	*Ratio of epoxide groups per amino group*[b]	*Shear strength at 250° F.*[c]
%		*p.s.i.*
1.90	15.7 to 1	112
2.25	13.3 to 1	400
2.95	10.2 to 1	2096
3.50	8.7 to 1	2928
4.00	7.5 to 1	3358
4.3	7.0 to 1	2678
5.2	5.6 to 1	1890
7.8	3.8 to 1	758
9.7	3.1 to 1	578

[a]Percent by weight of pentamethyl diethylene triamine based on weight of epoxy resin Epon RN-48.
[b]Ratio of reactive groups in resin (epoxide) to reactive groups in amine (amino) in adhesive mixtures.
[c]Tested immediately after reaching equilibrium at this temperature.

believed to be a major factor in reducing the stability of adhesives at high temperatures. A logical solution to this problem would then appear to be the utilization of some of the newer liquid resins which because of their reactivity, contain potentially 100% solids and can be cured without entrapment of solvents or loss of volatile by-products. One of these is the liquid epoxy type of resin.

Some further preliminary studies on such formulations were undertaken during the present investigation. Based on certain theoretical reasoning from the results of previous studies, one special amine, pentamethyl diethylene triamine, was selected for trial as a curing agent. Since this was not commercially available, Union Carbide and Carbon Chemicals Co. kindly synthesized this amine for the present work. This amine was used with Epon RN-48 liquid epoxy resin and gave strength values of 3000 p.s.i. at room temperature and as high as 3400 p.s.i. at 250° F. in aluminum lap shear specimens when cured at elevated temperatures. The adhesive can be applied as a liquid and pressed immediately at temperatures from room temperature to 300° F., with no previous air-drying or precuring.

In the evaluation of pentamethyl diethylene triamine as a curing agent for epoxy resin Epon RN-48, the amount of the amine was varied to study the relation of the ratio of the number of epoxide groups present in the resin to the number of amino groups present in the amine and their effect on the degree of cure and cross-linkage of the resin, as determined by shear strength of bonds tested at 250° F. The results of these tests of lap-joint specimens after a cure of 1 hr. at 200° F. and a postcure of 1 hr. at 300° F. are presented in Table IX, above.

The data show that a maximum shear strength at 250° F. was attained when 4% by weight of the amine was used as a curing agent. This combination of resin and amine apparently resulted in the optimum reaction of the reactive groups present in the mixture and resulted in optimum cross-linkage and thermal stability. Since this combination of amine and resin was most effective, it showed that on the average approximately 7½ epoxide groups from the resin were reacting with each of the 3 amino groups in the amine curing agent. This adhesive composition, composed of 100 g. of Epon RN-48 and 4 g. of pentamethyl diethylene triamine, is designated at FPL-881. These results are in close agreement with the mechanism of polymerization and cure of epoxide resins reported by Narracott (5) who showed, by the characterization of the products of triethylamine and phenylglycidyl ether, that 1 mono tertiary amine reacts with about 8 epoxide groups.

Table X: Shear strength of FPL-881 at various temperatures

Test temp.	*Shear strength*
° F.	*p.s.i.*
—70	3240
80	3110
250	2950
300	1040
400	570
500	380

The shear strength properties of formulation FPL-881 when tested immediately after reaching equilibrium at temperatures ranging from —70 to 500° F. are shown in Table X, below.

A rather abrupt loss in strength was observed in increasing the test temperature from 250 to 300° F., indicating that the adhesive was still somewhat thermoplastic at those conditions. A limited amount of additional work on the effect of ionic polymerization catalysts, such as iodine, and of chelating agents showed only a slight increase in the strength of bonds at 300° F.

This adhesive FPL-881 is believed to have distinctly improved strength properties at elevated temperatures over known conventional epoxy-resin adhesives and is considered to be a very promising approach to the problem of developing metal-bonding adhesives that have better heat resistance.

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Polyamide-epoxy resins

New polymers formed by the interaction of polyamides and epoxy resins presage a variety of new applications

By Don E. Floyd, William J. Ward*, and W. L. Minarik**

Polymers formed by condensing polybasic acids with substances containing more than one amino group have been known for a number of years. They are noted for strength and toughness. The polyamides manufactured by General Mills under the trademark Versamid from polymerized vegetable oil acids and polyamino compounds are thermoplastic resins well known for strength and toughness as well as strong adhesion. Conversion of these polyamides to thermoset resins by reaction with epoxy resins has opened up new applications through development of new properties. Data relating to resins used for coatings, adhesives, laminates, tools and potting are presented in this paper.

A new class of thermoset polymers has been prepared from the interaction of epoxy resins with polyamides prepared from polymerized vegetable oil acids (VOA) and polyamino compounds (1, 2).[1] There are certain important differences in this new class of products as compared with those obtained from reaction of epoxy resins with amine hardening agents:

1) VOA polyamides are relatively non-toxic and virtually non-volatile.

2) Pot lives of mixtures of VOA polyamides and epoxy resins are long because the heat of reaction develops slowly, permitting mixing of large batches.

3) Ratios of reactants are less critical than when ordinary epoxy hardening agents are used.

4) Toughness and impact resistance are markedly improved.

5) Products of greater flexibility can be prepared if desired, by increasing the ratio of polyamide to epoxy resin. This makes the system more adjustable to a wider range of requirements in physical hardness and flexibility.

In many other respects the reaction products of VOA polyamides with epoxy resins are similar to those of epoxy resins and amine hardeners—low shrinkage during cure, good wetting of glass fibers, cure without pressure, and high physical strength of the cured compositions.

In brief, VOA polyamides are polymeric curing agents for epoxy resins. No additional catalysts, hardening agents, or curing agents are needed. This is a complete reaction between two polymers.

This article describes applications that have been developed for three of these VOA polyamides—Versamids 100, 115, and 125. These particular resins have been synthesized to contain a high concentration of amino groups per unit weight and are, therefore, very reactive with epoxy resins. Typical properties of these three VOA polyamides are shown in Table I, below.

Surface coatings

VOA polyamide-epoxy compositions make excellent surface coatings (3). They have an especially fine combination of hardness and flexibility. They also show high gloss and excellent adhesion to many surfaces including glass, metal, wood, masonry, and many plastics. They differ from conventional surface coatings in that a chemical reaction takes place to produce cure without oxygen. In most other respects, the systems can be treated as other paint systems are treated, as in thinning with solvent, pigmentation, and methods of application. Since there are two components, it is possible to incorporate the pigment into a solution of either one or both components; for use the two components are mixed and thinner added.

Typical formulas and some of the properties of the resulting finishes are given in Tables II and III, p. 240. Paints formulated from Versamid 115 cure somewhat faster at room temperature than those formulated from Versamid 100. They are also slightly more resistant to solvents but a

Table I: Properties of VOA polyamides prepared for reaction with epoxy resins

	Versamid 100	*Versamid 115*	*Versamid 125*
Amine value	83-93	210-230	290-320
Viscosity			
at 25° C., poises	—	—	400-600
at 40° C., poises	—	500-750	80-120
Specific gravity	0.98	0.99	0.97
Physical state	Gum	Liquid	Liquid

*Research Laboratories, General Mills, Inc. Journal Series No. 193.

[1]Numbers in parentheses link to references at end of article, p. 250.

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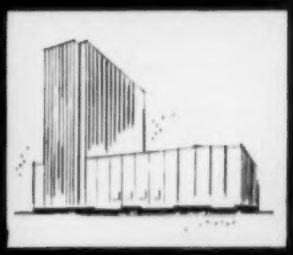

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Table II: Versamid 100-epoxy resin coatings[a]

Composition	*Clear*			*White*			*Yellow*			*Blue*		
	lb.	*gal.*	*wt.%*	*lb.*	*gal.*	*wt.%*	*lb.*	*gal.*	*wt.%*	*lb.*	*gal.*	*wt.%*
Pebble or ball mill base												
Epon resin 1001 (Shell Chemical Co.)	600	60.0		600	60.0		600	60.0		600	60.0	
Xylene	300	41.5		300	41.5		300	41.5		300	41.5	
Methyl isobutyl ketone	300	45.0		300	45.0		300	45.0		300	45.0	
Titanox RA50				850	24.3					850	24.3	
C.P. medium chrome yellow							1295	25.9				
Copper phthalocyanine blue										24	1.9	
Total base	1200	146.5	38.1	2050	170.8	51.3	2495	172.4	56.2	2074	172.7	51.6
Versamid 401 solution (60% non-volatile in a 9:1 ratio of xylene and Cellosolve)	1000	129.6	31.7	1000	129.6	25.0	1000	129.6	22.5	1000	129.6	24.8
Reducer												
Xylene	850	118.2		850	118.2		850	118.2		850	118.2	
Cellosolve	100	13.0		100	13.0		100	13.0		100	13.0	
Total reducer	950	131.2	30.2	950	131.2	23.7	950	131.2	21.3	950	131.2	23.6
Sum total	3150	407.3	100.0	4000	431.6	100.0	4445	433.2	100.0	4024	433.5	100.0
Properties												
Viscosity of base	Gardner Tube-A			Stormer 90 K.U.			100 K.U.			90 K.U.		
Viscosity of total mix (No. 4 Ford cup), sec.	20			21			24			24		
Non-volatile in vehicle, %	38.1			38.1			38.1			38.1		
Non-volatile in total mix, %	38.1			51.3			56.1			51.6		

[a]A variety of other pigmentations may be readily prepared with both Versamids 100 and 115. Wetting agents such as Tenlo 70 (Griffin Chemical Co.), lecithin, or a trace of a silicone (e.g., 0.01% Dow DC-200) have been found effective in the elimination of floating and silking.

Table III: Versamid 115-epoxy resin coatings

Composition	*Clear*			*White enamel*		
	lb.	*gal.*	*wt.%*	*lb.*	*gal.*	*wt.%*
Pebble or ball mill base						
Epon resin 1001	600	60.0		600	60.0	
Xylene	300	41.5		300	41.5	
Methyl isobutyl ketone	300	45.0		300	45.0	
Titanox RA50				680	19.4	
XX601 acicular zinc oxide				170	3.6	
Total base	1200	146.5	52.0	2050	169.5	65.0
Add to base when ready to use:						
Versamid 115[a]	323	39.4		323	39.4	
Xylene	126	17.6		126	17.6	
Cellosolve	14	2.0		14	2.0	
Total Versamid solution	463	59.0	20.0	463	59.0	14.6
Reducer						
Xylene	580	80.4		580	80.4	
Cellosolve	64	10.0		64	10.0	
Total reducer	644	90.4	28.0	644	90.4	20.4
Sum total	2307	295.9	100.0	3157	318.9	100.0
Properties						
Viscosity of base	Gardner Tube-A			90 K.U. (Stormer)		
Viscosity of total mix (No. 4 Ford cup), sec.	20			23		
Non-volatile in vehicle, %	40.0			40.0		
Non-volatile in total mix, %	40.0			56.2		

[a]The 70% non-volatiles solution in xylene-Cellosolve, 9:1, is recommended, although other solvent combinations may be used. This solution, having a viscosity (Gardner-Holdt) of approximately Z, should be prepared prior to adding to the ball mill base.

little less resistant to strong acids. Both types may be cured at either room temperature or at elevated temperature. Versamid 125 was designed especially for castings, pottings, and laminates, but is also useful with epoxy resins in surface coatings.

Coatings made from VOA polyamides and epoxy resin combinations may be cured at room temperature or at elevated temperatures up to 400° F. Because of the excellent physical characteristics and corrosion resistance of the films, they are well suited as industrial maintenance paints and as protective finishes for many metal articles and structures (Figs. 1 and 2, p. 242).

Adhesives

VOA polyamides and epoxy resin mixtures may be used for a wide range of adhesive systems (4). Where structural strength is required, as in bonding metals (for example, aircraft aluminum bonding), certain types of for-

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1 The mold involved a "gate" .015 deep x .020 wide demanding a steel that would wear well at this point and automatically "degate" leaving no trim edge on the part.

2 Due to the extensive pantographing required on the mold, the mold steel had to possess excellent machinability characteristics. Also, the steel had to polish to a high lustre.

3 Since the molder had to be in production within six weeks after receipt of order, it was essential that a prehardened type of steel be used. To further minimize mold building time, it was advantageous to have different sections of the mold built by two mold makers. With a prehardened steel, this could be done without fear of mismatching mold parts due to size change in heat treatment.

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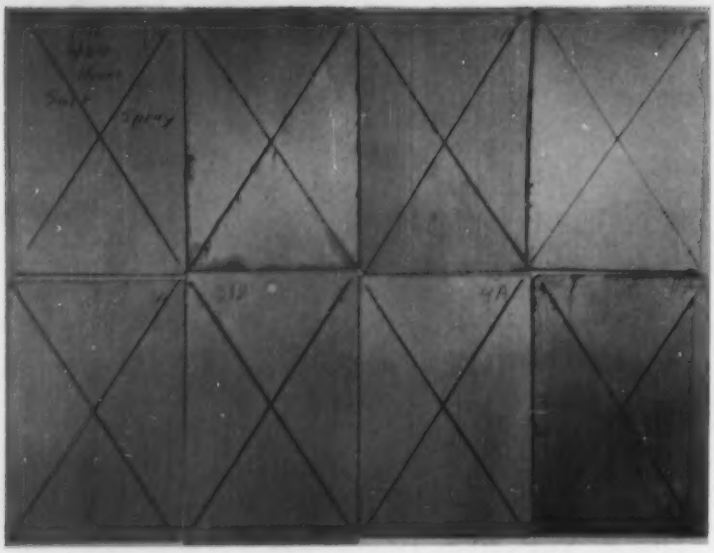

Fig. 1: Polyamide-epoxy resin films after 400 hr. in a salt spray cabinet. 1A—Versamid 100-Epon 1001 (50:50), air-dried; 1B—Versamid 100-Epon 1001 (50:50), baked; 2A—Versamid 115-Epon 1001 (35:65), air-dried; 2B—Versamid 115-Epon 1001 (35:65), baked; 3A—ethylene diamine-Epon 1001 (6:100), air-dried; 3B—diethylene triamine-Epon 1001 (6:100), baked; 4A—Versamid 115-Epon 1001 (50:50), air-dried; 4B—Versamid 115-Epon 1001 (50:50), baked

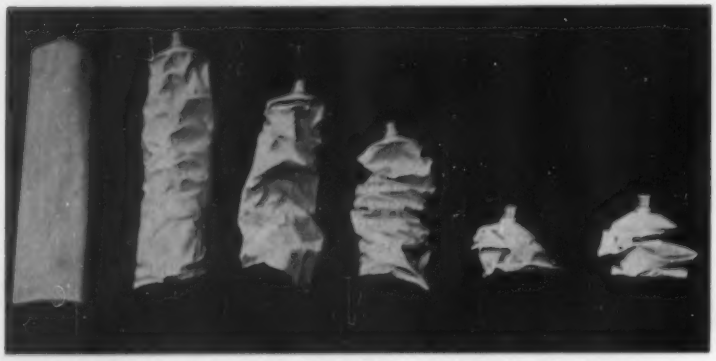

Fig. 2: Collapsible tubes coated with white enamel made of a half-and-half blend of Versamid 100 and Epon 1001. The enamel remains undamaged despite repeated crushing of the tubes

Table IV: Effect of fillers on tensile shear strength of VOA polyamide-epoxy adhesives[a, b]

Filler	Tensile shear[c]	
	Room temp.	—104° F.
	p.s.i.	p.s.i.
Tabular alumina (Alcoa, Pitts., Pa.)	3200	3450
AFD filler (Aluminum Flake Co., Akron, Ohio)	3420	3030
Metronite (J. W. Copps, Milwaukee, Wis.)	2760	——
Surfex MM (Diamond Alkali, Cleveland, Ohio)	2730	——
Suspenso (Diamond Alkali, Cleveland, Ohio)	2900	2840
Nylon powder (Nat. Polymer Products, Reading, Pa.)	2940	2150
The following compositions were also tested:		
Versamid 115:Araldite 502:Metronite (4:6:2)	3060	3310
Versamid 115:Epon 828:Metronite (3:7:2)	2700	——

[a] Standard composition: Versamid 115:ERL 2795:Filler (50:50:20).
[b] The epoxy resins were obtained from the following sources: ERL 2795—Bakelite Co.; Araldite 502—Ciba Co.; Epon 828—Shell Chemical Co.
[c] ASTM D 1002-49T.

mulas are preferred. Typical data are given in Tables IV, below and V, p. 247. Strong bonds are formed without applying external pressure. They have high rigidity and high structural strength, while showing excellent impact resistance. In the tests reported here, bonding areas 1 in. wide with ½-in. overlap on 24ST aluminum were used. The aluminum was pretreated only by light sanding, although it is realized that greater bond strength may be expected if chemical pretreatments, such as chromate etch, are used.

Where high peel strength is desired and rigidity is not needed, compositions of higher polyamide to epoxy ratio are preferred. Such compositions are excellent for bonding Mylar film to itself or to other substances, for bonding copper or brass to printed circuit bases, and for other uses where high peel strength is desired. These mixtures are handled and cured much in the same manner as the structural adhesive formulations but differ principally in composition. A typical composition is one containing 75 parts of Versamid 115 and 25 parts of epoxy resin ERL 2795 (Bakelite Co.). Epoxy resins such as Araldite 502 (Ciba Co.) and Epon 828 (Shell Chemical Co.) may also be used. Peel strengths of about 5 to 15 lb./in. of width, as determined by the procedure of the National Electrical Manufacturers' Association or ASTM method D 90-49, may be expected.

Electrical uses

For electrical potting and encapsulating, Versamids 115 and 125 are preferred over Versamid 100 because of greater fluidity (5). It is best to warm Versamid 115 slightly before mixing with the epoxy resin in order to reduce the viscosity. Temperatures near 60° C. will reduce viscosity without seriously limiting pot life (Fig. 3, p. 248). Such blends have excellent physical, electrical, and chemical properties. Some of these properties are shown in Table VI, p. 247. Tables VII and VIII, p. 247, give data on shrinkage during cure and pot life. Figure 4, p. 248, shows exotherm

(*To page* 247)

Long awaited...

On the next two pages appears an announcement of a new plastic—a molding material with a unique combination of properties that answers a long-felt need of industry.

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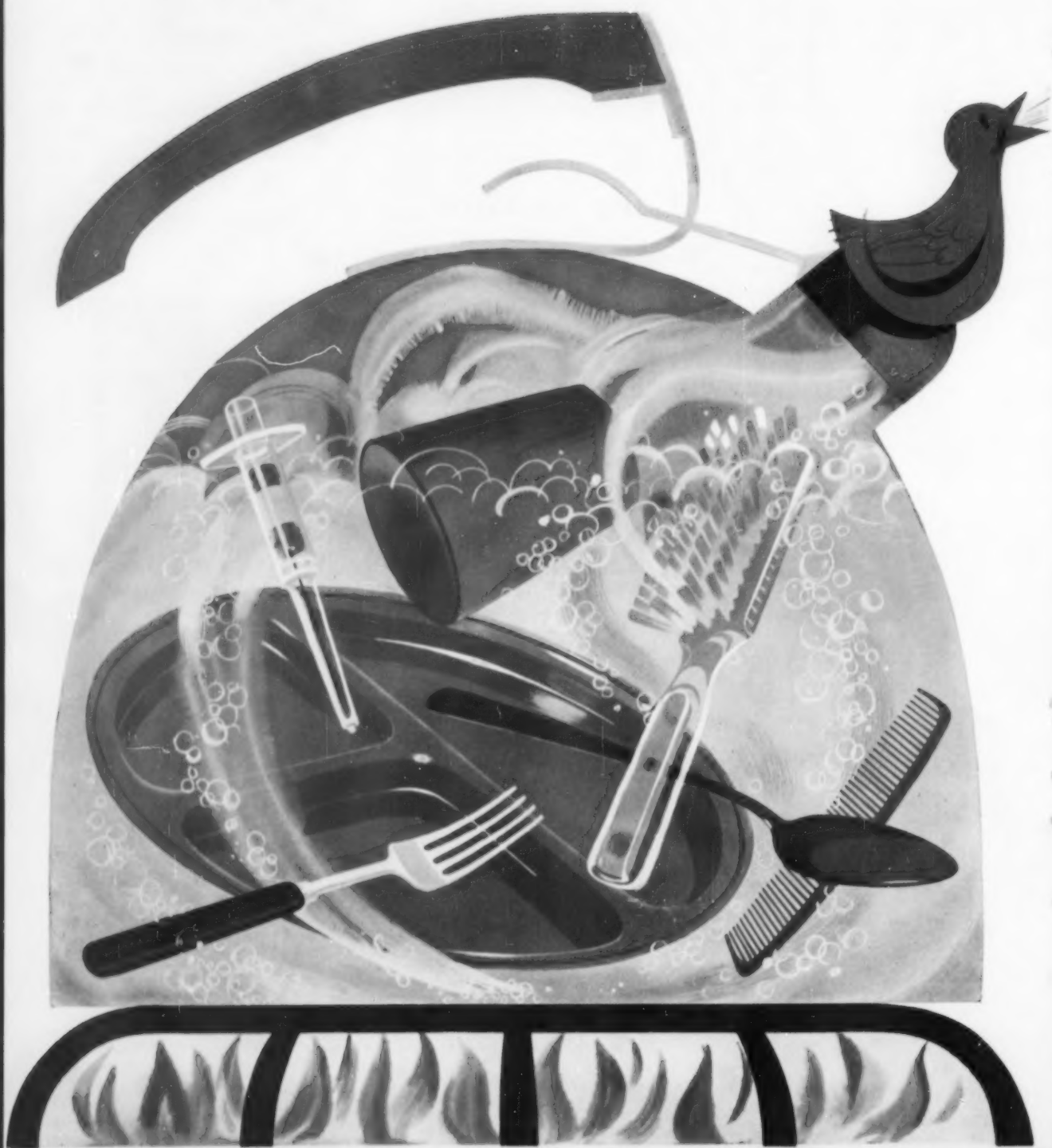

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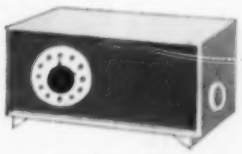

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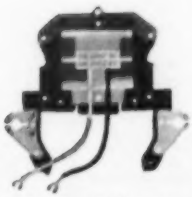

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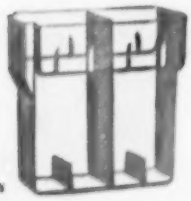

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Table V: Effect of immersion in various fluids on tensile shear strength[a] of filled adhesives

Composition	Tensile shear before immersion	Tensile shear after immersion in: Hydraulic fluid	Motor oil (SAE #10)	Aviation gasoline	Tap water
	p.s.i.	p.s.i.	p.s.i.	p.s.i.	p.s.i.
Versamid 115: Araldite 502: Metronite (2:3:1)	3060	3080	3130	2890	2790
Versamid 115: ERL 2795: AFD filler (5:5:2)	3420	2870	2730	2730	2710
Versamid 115: ERL 2795: nylon powder (5:5:2)	2940	2760	2760	3060	2880
Versamid 115: ERL 2795: tabular alumina (5:5:2)	3200	3170	3250	3270	3170

[a]ASTM D 1002-49T and MIL-A-5090b

Table VI: Properties of potting compounds made with VOA polyamides and epoxy resins tested in accordance with Military Specification I-16923B

Composition	Mechanical shock: weight of ball causing failure (avg.)	Moisture vapor permeability (avg.)	Moisture absorption	Rate of burning	Dielectric strength[b]	Coefficient of linear thermal expansion
	lb.	10^{-6} g./hr./cm.	%	in./min.	kv./mil	10^{-5} in./in./° F.
Versamid 115: ERL 2795 (50:50)	7.8	0.57	0.77	1.0	2.17	2.5
Versamid 115: Araldite 502 (40:60)	9.4	1.30	0.95	0.95	1.89	4.3
Versamid 125: ERL 2795 (40:60)	7.8	0.90	0.69	1.05	1.90	3.7
Versamid 125: Araldite 502 (30:70)	7.8	0.48	0.75	1.17	2.10	5.1
Requirement (all types)	4.0 min.	20 max.	1.0 max.[a]	—	0.325 min.	17 max.

[a]Type B only
[b]Specimens 10 to 15 mils thick

Table VII: Shrinkage during cure in open top mold of VOA polyamide-epoxy resin compositions

Composition	Cure temperature	Shrinkage
	° F.	in./in.
Versamid 115: Araldite 6010 (50:50)	150	0.008
Versamid 115: Araldite 502 (40:60)	150	0.008
Versamid 115: Araldite 502 (40:60)	300	0.016
Versamid 115: ERL 2795 (50:50)	300	0.015
Versamid 115: Epon 828 (30:70)	300	0.011

Table VIII: Pot life[a] of VOA polyamide-epoxy resin compositions

Composition	Usable pot life	Batch size	Max. temp. reached
	min.		° C.
Versamid 125: ERL 2795 (40:60)	90	1 gal.	151
Versamid 125: Araldite 502 (30:70)	70	1 gal.	174
Versamid 115: ERL 2795 (50:50)	260	200 g.	34
Versamid 125: ERL 2795 (40:60)	90	200 g.	116

[a]Ambient temperature 24° C.

versus time and Fig. 5, p. 248, shows pot life at constant temperature for typical blends used in potting electrical components (Fig. 6, p. 250).

Castings—tool and die

Casting compounds are much like the encapsulation and embedment compounds in composition but the uses are different. The casting compounds are well fitted for core materials, tool and die structures, master models, glass-reinforced plastics tools, and molded articles. Excellent conformity to the mold, excellent adhesion to many substances, low shrinkage during cure, and good dimensional stability contribute to the usefulness for these applications. They are also highly re-

sistant to impact and very tough. Hardness values for some typical compositions are shown in Table IX, below.

Alone or with suitable reinforcement or fillers these compositions show exceptional promise for tools, jigs, fixtures, forming dies, surfacing dies, draw dies, and master models for the metal-forming industries.

Soft Versamid 125-epoxy castings show exceptional promise for soft-face drop-hammer dies, resilient hydroform dies, and soft castings. For example, blends of 60 parts Versamid 125 to 40 parts epoxy resin have made excellent resilient drop hammer die facings. The ratio may be varied from 60:40 to 70:30, depending on the nature of the job.

Large masses can be mixed and cured at one time, making the blends more convenient to use than other common tooling resins. These mixtures may be used in preparing core materials, tools, and other structures (Fig. 7, p. 250). Some of the physical strength properties are shown in Table X, below.

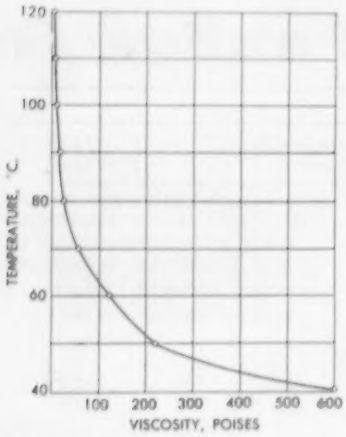

Fig. 3: Viscosity of Versamid 115 at different temperatures. Warming to 60° C. reduces viscosity, does not seriously limit pot life

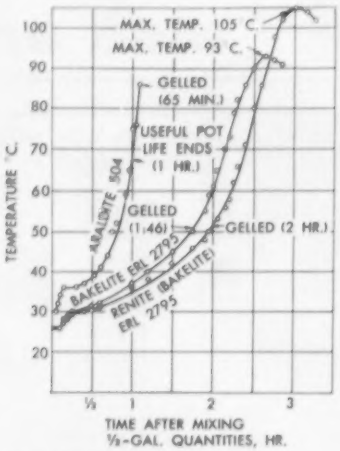

Fig. 4: Pot life and exotherm studies for 1:1 blends of Versamid 115 and various epoxy resins

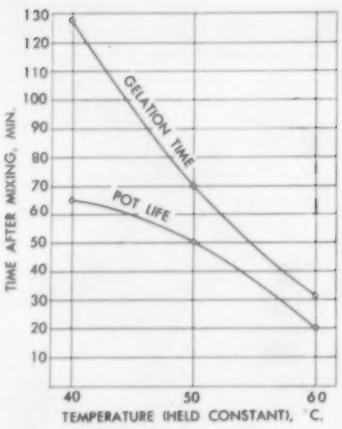

Fig. 5: Pot life and gelation of Versamid 115: ERL 2795 (1:1) held at constant temperature

Reinforced plastics

In laminated structures, the excellent wetting characteristics and the excellent adhesion of VOA polyamide-epoxy materials to glass fibers and other common reinforcing materials make them especially suitable. Clear amber laminates may be prepared by hand lay-up or in matched metal dies. No pressure is required in preparing such laminates and it is not necessary to pre-impregnate the glass before preparing it. One of several methods may be followed. The desired number of layers of glass fabric may be placed in a mold, the liquid resin poured on top, the mold closed, and the structure cured with

Table IX: Hardness values of VOA polyamide-epoxy castings

Composition	Hardness	
	Barcol[a]	Shore Durometer A
Versamid 125:ERL 2795 (40:60)	60-65	—
Versamid 125:ERL 2795 (50:50)	20-25	—
Versamid 125:ERL 2795 (60:40)	—	90
Versamid 125:ERL 2795 (70:30)	—	50
Versamid 125:ERL 2795 (75:25)	—	30
Versamid 125:ERL 2795 (80:20)	—	5

[a]Barcol Impressor Model GYZJ-935

Table X: Physical strength properties of typical VOA polyamide-epoxy castings

Composition	Compressive yield point (ASTM D 695-52T)	Tensile strength (ASTM D 638-52T)	Elongation (ASTM D 638-52T)	Flexural modulus (ASTM D 790-49T)	Flexural strength (ASTM D 790-49T)
	p.s.i.	p.s.i.	%	10^5 p.s.i.	p.s.i.
Versamid 115:ERL 2795 (50:50)	7300	4600	9.0	3.0	8300
Versamid 115:Araldite 6010 (45:55)	12,000	5700	9.3	2.3	9300
Versamid 125:ERL 2795 (40:60)	9100	6600	—	—	—

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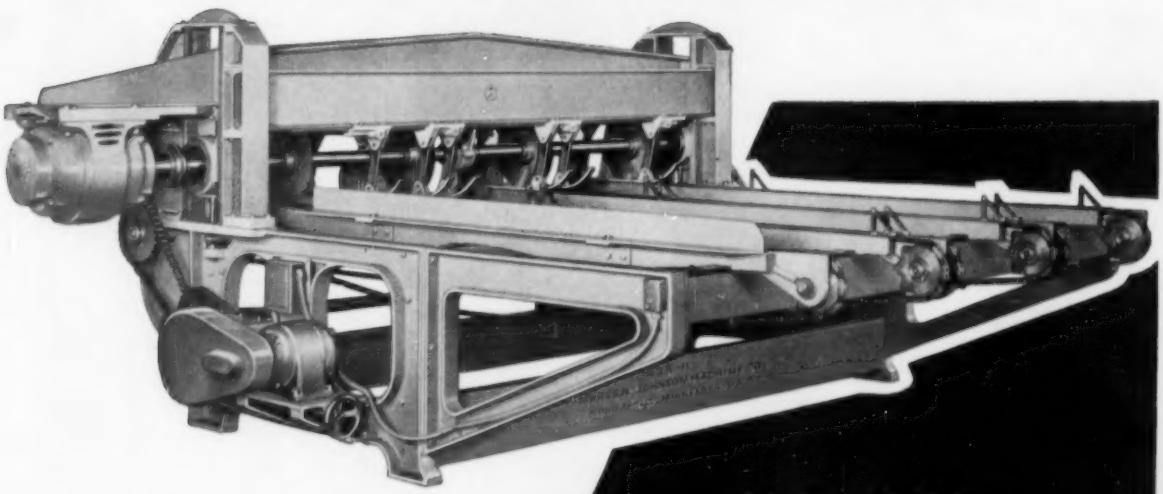

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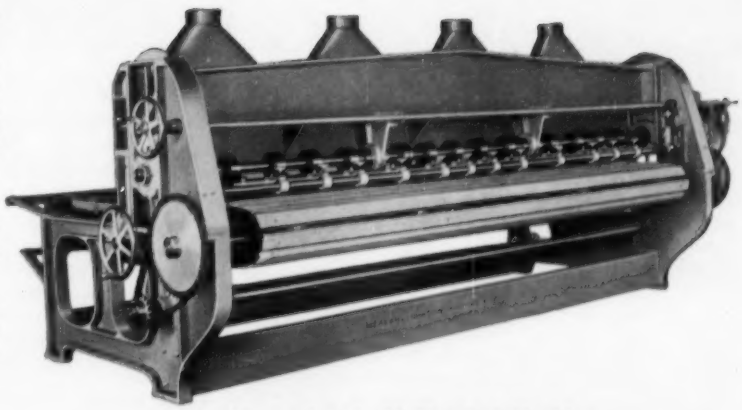

Rear View of 144x48 Slat Bed Machine

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Table XI: Properties of laminates[a] made with Versamid 115-epoxy resin compounds[b]

Resin combinations	Parts	Flexural strength (ASTM D 790-49T)	Flexural modulus of elasticity (ASTM D 790-49T)	Tensile strength (ASTM D 638-52T) 80° F.	Tensile strength (ASTM D 638-52T) 250° F.
		p.s.i.	10^6 p.s.i.	p.s.i.	p.s.i.
Versamid 115 ERL 2795	1 1	60,000	2.5	50,000	20,000
Versamid 115 Araldite 6020	3 4	62,000	1.7	40,000	19,000
Versamid 115 Araldite 502	2 3	55,000	—	34,000	14,000
Versamid 115 ERL 2774	3 4	60,000	2.5	39,000	19,000
Versamid 115 Epon 828 Metaphenylenediamine	100 200[c] 7.5	48,000	—	33,000	16,000

[a] Laminates are 35% resin, 65% glass (6-ply, 181 Fiberglas cloth), 0.060 in. thick.
[b] Versamid 125 can be handled more readily than Versamid 115 in glass cloth laminates because of its lower viscosity. Physical strength data of laminates made from Versamid 125-epoxy combinations are not presently available.
[c] ERL 2774 or Araldite 6010 may be substituted for the Epon 828 in the formulation. See also reference (6).

Fig. 6: Electronic assembly consists of selenium rectifier embedded in a cured potting resin compound which was produced from Versamid 115 and a liquid epoxy resin

heat. Or, the laminates may be prepared by hand by impregnating the glass fabric one layer at a time and working the resin mix through the fabric with a stiff brush. It has also been found that the matched die procedure may be followed without the use of a mold, by pressing the laminates down to a thickness maintained by Teflon shims on the edges of the press.

The VOA polyamide-epoxy laminates are not sensitive to the type of finishing agent used on the glass reinforcement. In fact, they show excellent wetting even when heat-cleaned glass is used. However, for purposes of comparison, in Table XI, above, are shown some of the characteristics of laminates made with 181-114 glass cloth and VOA polyamide-epoxy laminating mixtures. These laminates show considerable promise for fabrication of glass-reinforced plastics pipe, printed circuit bases, radome structures, boats, and other structural items (Fig. 8, below).

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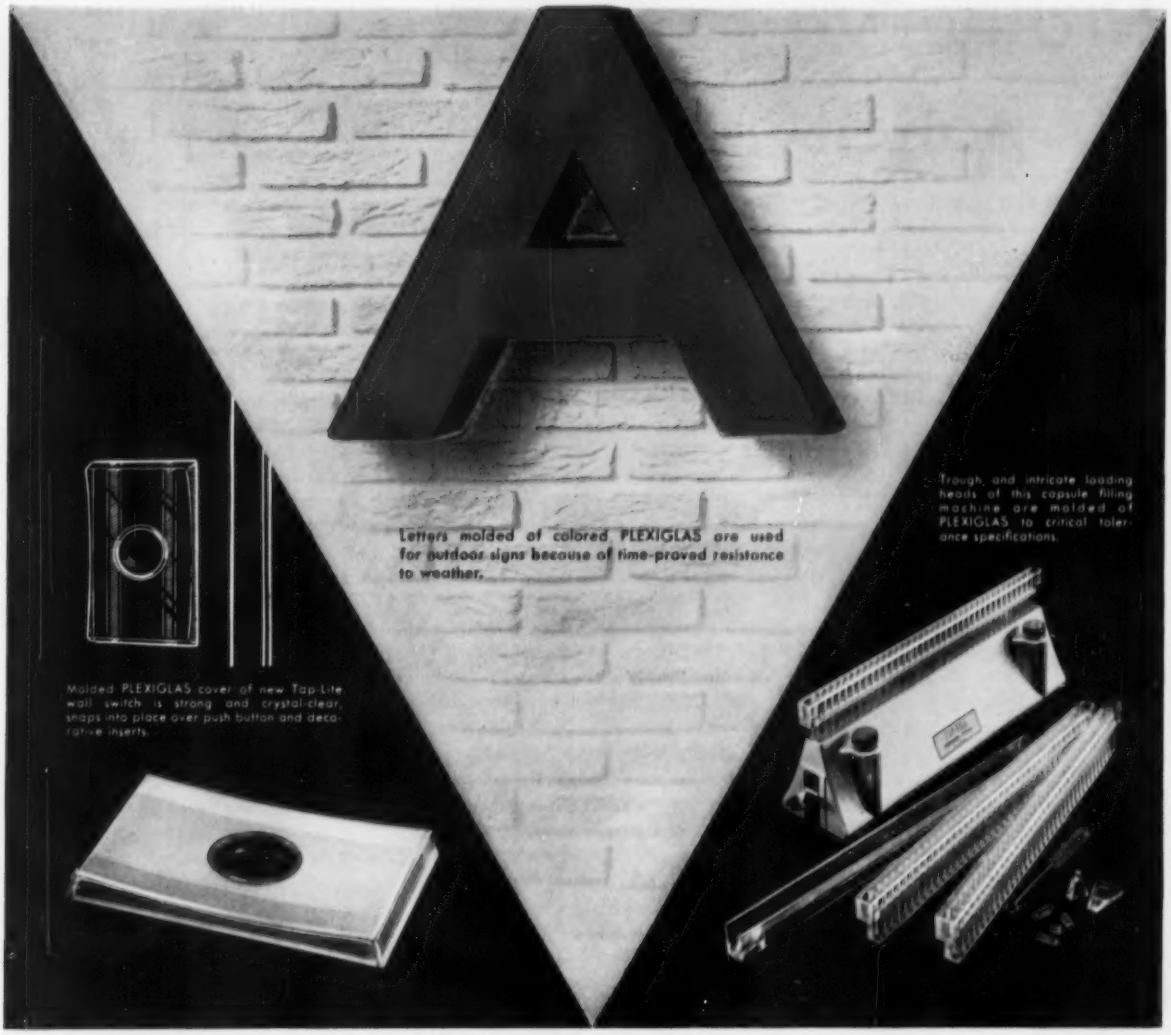
Fig. 7: Pair of drop-hammer dies made from Versamid-epoxy casting material are used successfully in making aluminum stampings (in center of photo) at McDonnell Aircraft Co., St. Louis, Mo.

Fig. 8: Glass-reinforced Versamid-epoxy hull, Versamid-Epon-coated deck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Protective coatings for polystyrene

By J. A. Snyder, C. F. Martino*, J. R. Wilkinson*, and E. H. Wood**

Results obtained with coated polystyrene show the extent of the improvement in weathering life that the application of a good coating produces. They indicate that where the specific properties of a polystyrene resin are advantageous, its lack of exceptional weathering properties need not be an unsurmountable obstacle to the use of the resin.

The position of polystyrene as one of the major plastics has been enhanced because of its ease of forming, hardness, attractive appearance, and economy. Still, along with the many improvements made in polystyrene resins and compounds since their introduction, these plastics exhibit a minimum ability to withstand exposure to outdoor environments. Under such conditions, they have a marked tendency to become dull, craze, develop crack marks, discolor, and lose retention of important physical properties. Ultra-violet light, for example, represents a major cause of each of the above-mentioned, undesirable effects. Thus, the exclusion of ultra-violet light by the application of a protective coating should provide polystyrene with an indefinitely long life if the coating were periodically renewed. A class of such protective coatings has been found to be quite satisfactory for protecting polystyrene when subjected to both natural and artificial weathering.[1]

Frequently, paints are used on plastics for decorative purposes. On the other hand, plastics normally are not coated to give them good weathering properties. This fact seems a little strange considering the general acceptance of the necessity for painting wood, iron, and other conventional materials. The newness of plastics and their high cost relative to wood have probably combined to prevent their being used as widely as possible outdoors, either coated or uncoated. However, the low specific gravity and cost-per-pound of polystyrenes make them attractive cost-wise for outdoor uses even when the additional cost of a coating is considered.

A satisfactory outdoor coating must satisfy the following requirements:

1) The solvent used with the coating must not attack the plastic nor degrade its physical properties.

2) The coating should air-dry quickly to a hard, tough, glossy finish.

3) The coating must protect the polystyrene and must, itself, have good weathering resistance characteristics.

4) A variety of colors and a transparent formulation should be readily achieved.

5) The coatings should be easily applied by brushing, dipping, or spraying.

6) Multiple coats must adhere

Table I: Typical coatings for imparting weathering resistance to polystyrene

Coating	*Composition*	*Supplier[a]*	*Amount % by wt.*
Black, semi-gloss	Polymethyl methacrylate	1	12.01
	Carbon black	2	6.68
	Wetting agent	3	0.09
	Diacetone alcohol	4	13.22
	Methyl Cellosolve	4	68.00
Clear, glossy	Polymethyl methacrylate	1	10.99
	"Univul 400"	5	1.10
	Diacetone alcohol	4	25.67
	Methyl Cellosolve	4	62.24
Aluminum, metallic	Polymethyl methacrylate	1	13.97
	Aluminum powder	6	6.36
	Wetting agent	3	0.04
	Diacetone alcohol	4	10.13
	Methyl Cellosolve	4	69.50

[a] Code to suppliers and products

1. Rohm & Haas Co., Philadelphia, Pa.	Plexiglas VM-100
2. Godfrey L. Cabot, Inc., Boston, Mass.	Monarch 74
3. American Cyanamid Co., New York, N. Y.	Aerosol AY
4. Carbide and Carbon Chemicals Co., New York, N. Y.	Cellosolve
5. General Dyestuff Corp., New York, N. Y.	Univul 400
6. Metals Disintegrating, Inc., Elizabeth, N. J.	MD-5110

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*Development Dept., Bakelite Co., a Div. of Union Carbide and Carbon Corp.

[1] Similar coatings are described in U. S. Patent No. 2,578,665.

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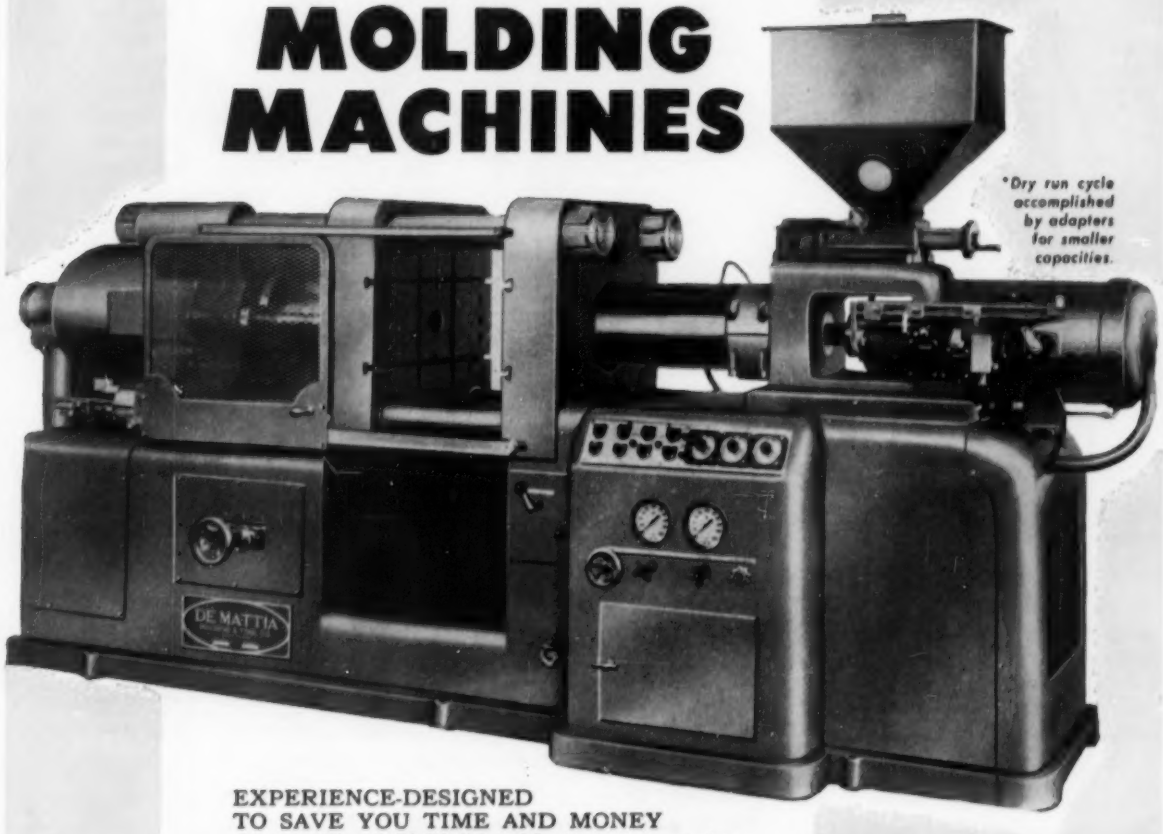

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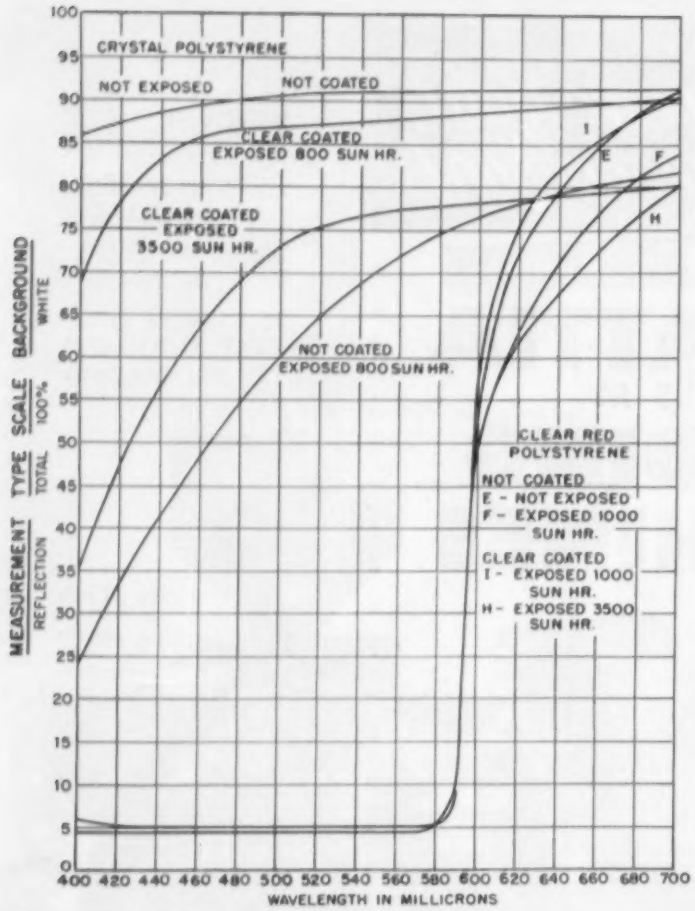


Fig. 1: Spectrophotometric reflectance for clear-coated standard Bakelite polystyrene exposed outdoors at Bound Brook, N. J.

to each other and repainting should be as simple an operation as possible.

Solutions of methyl methacrylate resins in diacetone alcohol and methyl Cellosolve satisfied the above requirements when applied on polystyrenes and high impact polystyrenes. Typical formulations are given in Table I, p. 252.

These lacquers are reasonable in cost because of the very thin film required (0.0001 to 0.0005 inch.). One gallon will cover approximately 1000 sq. ft. of area 0.00016 in. thick, which at a cost of $10/gal. results in an actual coating cost of 1¢/sq. ft. provided that none of the solvent were recovered.

Clear coatings

An ultra-violet absorbing agent is necessary for maximum endurance of clear or lightly pigmented coatings, although highly pigmented coatings do not need such an additive. Polystyrene samples (white) coated with the preferred clear lacquer of Table I did not discolor perceptibly until after more than 1 yr. of outdoor exposure at Bound Brook, New Jersey[2], while uncoated samples discolored in less than 2 months. The best clear coating protected polystyrenes containing light-stable colorants for 3 yr. outdoors before slight dulling indicated incipient coating failure. Discoloration was absent. Uncoated, these polystyrenes became crazed and dulled within 12 mo., although only slightly discolored. The colorless coating containing an ultra-violet screening agent prevented discoloration of natural crystal polystyrene for 6 mo. (Fig. 1). Yellowing is normally noted after 2 mo. exposure of crystal polystyrene outdoors at Bound Brook. However, since the detrimental ultra-violet light

(*To page* 425)

[2]All outdoor exposures met the general requirements of A.S.T.M. D 518-44 test. The samples were placed at 45° to the horizontal, facing south.

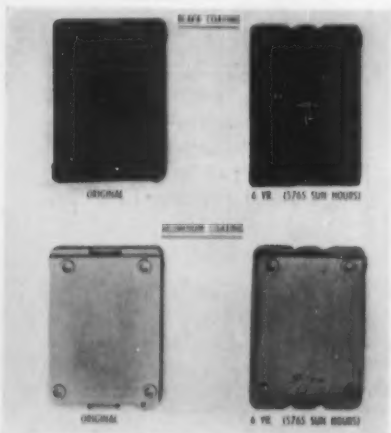
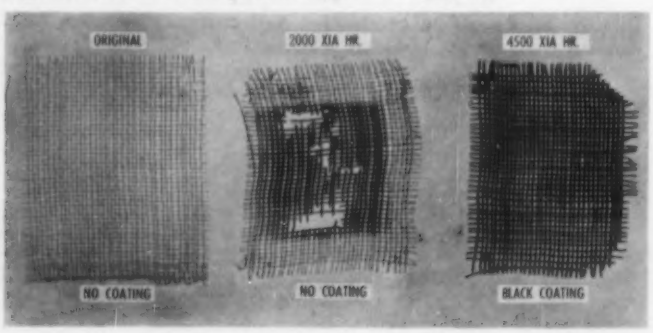
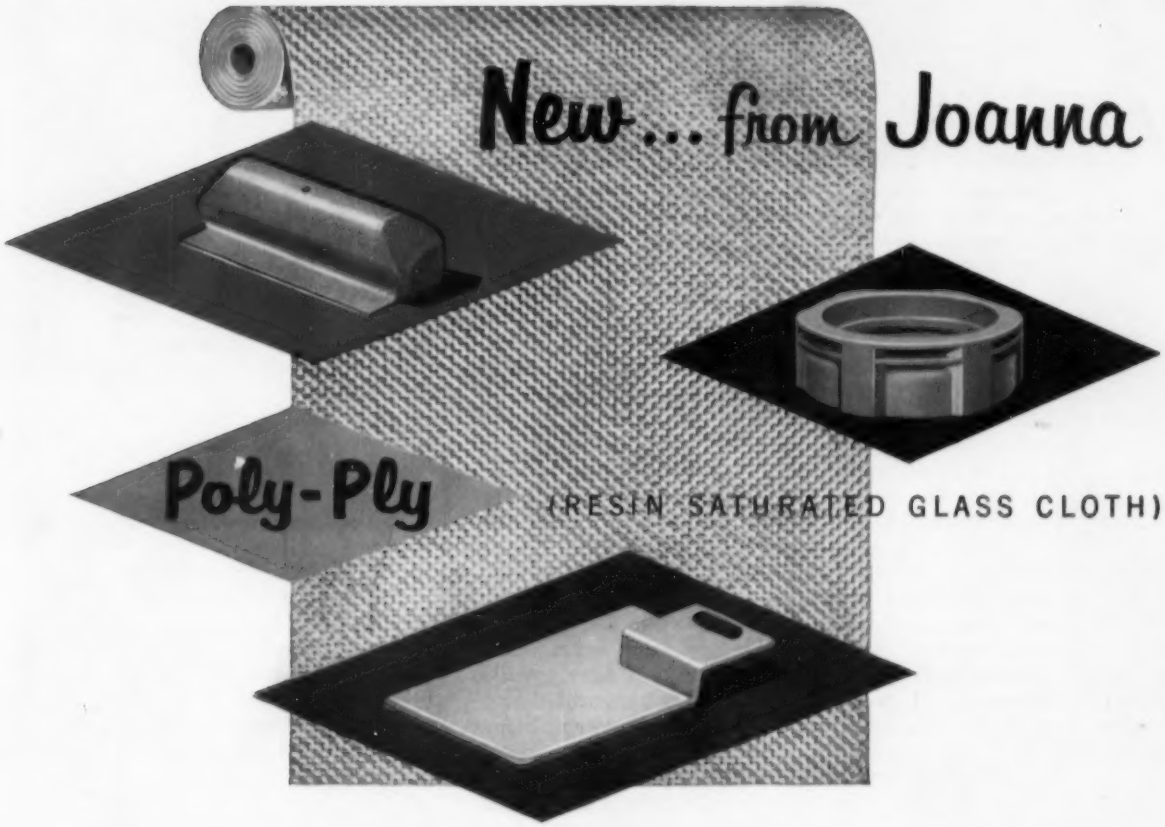


Fig. 2: Results of outdoor exposure of coated polystyrene samples at Bound Brook, N. J.

Fig. 3: Results of accelerated exposure of polystyrene screen





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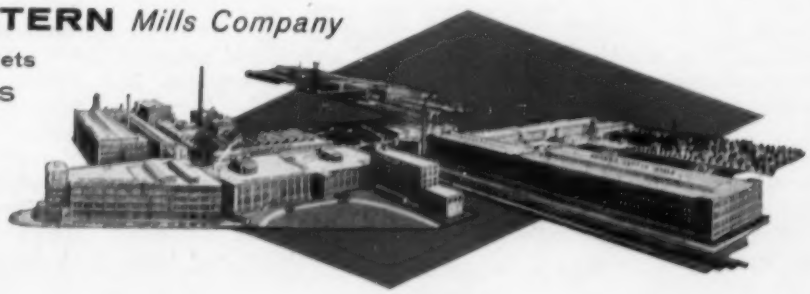

Plastics Digest

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

High polymeric materials. O. Leuchs. Kunststoffe *45*, 323-34 (Aug); 375-82 (Sept.); 511-19 (Nov. 1955). International standardization of definitions for high polymers is discussed. The materials are characterized not by their source as natural and synthetic high polymers but by their molecular configuration and the intermolecular forces involved. They are grouped into eight categories: 1) polyenes; 2) polyethers; 3) polyesters; 4) polyamides; 5) aldehydes; 6) other organic high polymers; 7) semiorganic; and 8) inorganic materials. A 10-page table based on these groups is included. The eleven columns of the table contain among other information a numerical listing, chemical and tradenames, kind of polymerization, chemical formula, and intermolecular forces. An alphabetical index contains polymers and copolymers, German trade names, and the chemical name used in the table.

Materials

Surfactant-treated minerals as reinforcing fillers. A. S. Michaels. Ind. Eng. Chem. *48*, 297-304 (Feb. 1956). Treatment of mineral fillers such as kaolinite or wollastonite with small controlled quantities of selected surface-active agents is accompanied by improvement in strength and stiffness of plastic or elastomeric products containing 50% by weight of filler, provided the untreated filler does not disperse readily in the resins with which it is compounded. Excessive treatment of the filler is detrimental to physical properties. Surfactant treatment causes reduction in strength and stiffness of compounds based on resins in which the filler disperses readily without treatment. Surfactant treatment of mineral fillers permits the preparation of very highly filled (90% by weight of filler) plastic compositions with good physical properties. The role of filler treatment in this application appears to be enhancement of uniformity of distribution of the binding resins, and a preferential wetting of filler particles by resin. Filler treatment also appears to improve water resistance of these highly filled compositions. The strength of highly filled plastic compositions is markedly dependent on the densification achieved during fabrication. Whereas surfactant treatment of the filler appears to facilitate densification, the mechanics of the compaction process are of critical importance in obtaining high quality products.

Low-pressure polyethylene. K. Zeigler. Kunststoffe *45*, 506-07 (Nov. 1955). In the so-called "Mulheim" polymerization process (Zeigler process in the U. S. A.) ethylene is completely and rapidly polymerized at temperatures ranging from 20 to 70° C. Molecular weight ranges from 10,000 to 3 million. The metallic catalysts used in the process are described and a theory of the new polymerization process is presented.

Curing of unsaturated polyester resins at low temperatures. B. Berndtsson and L. Turunen. Kunststoffe *46*, 9-14 (Jan. 1956). The effects of time and temperature on the flexural strength, modulus of elasticity in flexure, Rockwell indentation hardness, dimensional stability, and luminous transmittance of polyester resins with and without fibrous glass reinforcements were investigated. It was found that the properties of the final products vary widely depending upon curing conditions.

Copolymerization of vinyl silanes. B. R. Thompson. J. Polymer Sci. *19*, 373-77 (Feb. 1956). A brief experimental investigation was made of the copolymerization of twelve alkoxysilanes with monochlorostyrene, vinyl chloride, and acrylonitrile. These new monomers include vinyltrimethoxy-, vinyltriethoxy-, vinyltriisoproxy-, vinylmethyldiethoxy-, vinylethyldiethoxy-, and vinylphenyldiethoxy-silanes as well as allyl-, propenyl-, 2 butenyl-, Δ^3-cyclohexenyl-, 6-triethoxysilylbicyclo-[2.2.1] heptene-2, and α-chlorovinyltriethoxysilanes. No copolymerization took place with monochlorostyrene. In the copolymerizations with vinyl chloride, and with acrylonitrile, the reactivity ratio was assumed to be zero.

Irradiation of long-chain polymers. A. Charlesby. Chem. Eng. Prog. *51*, 476-78 (Oct. 1955). A brief resume is given on how radiation is successfully, and not-so-successfully, being used to produce unusual cross-linkages in plastics. High-energy radiation may produce cross-linking in some polymers, or depolymerization in others. Cross-linking occurs when fracture of side chains produces activated molecules or radicals which can then attack a neighboring molecule and form a permanent link with it. If the chain fragments formed can be stabilized by rearrangement of a few atoms, a permanent break results, and the average molecule weight is reduced. In general, polymers with two side chains tend to suffer main-chain fracture, and polymers with one or no side chains tend to cross-link. Radiation-induced reactions appear to progress in stages, as is demonstrated by the possibility of modifying such reactions by the addition of small amounts of inhibitors which cannot directly absorb an appreciable proportion of the incident energy, yet can

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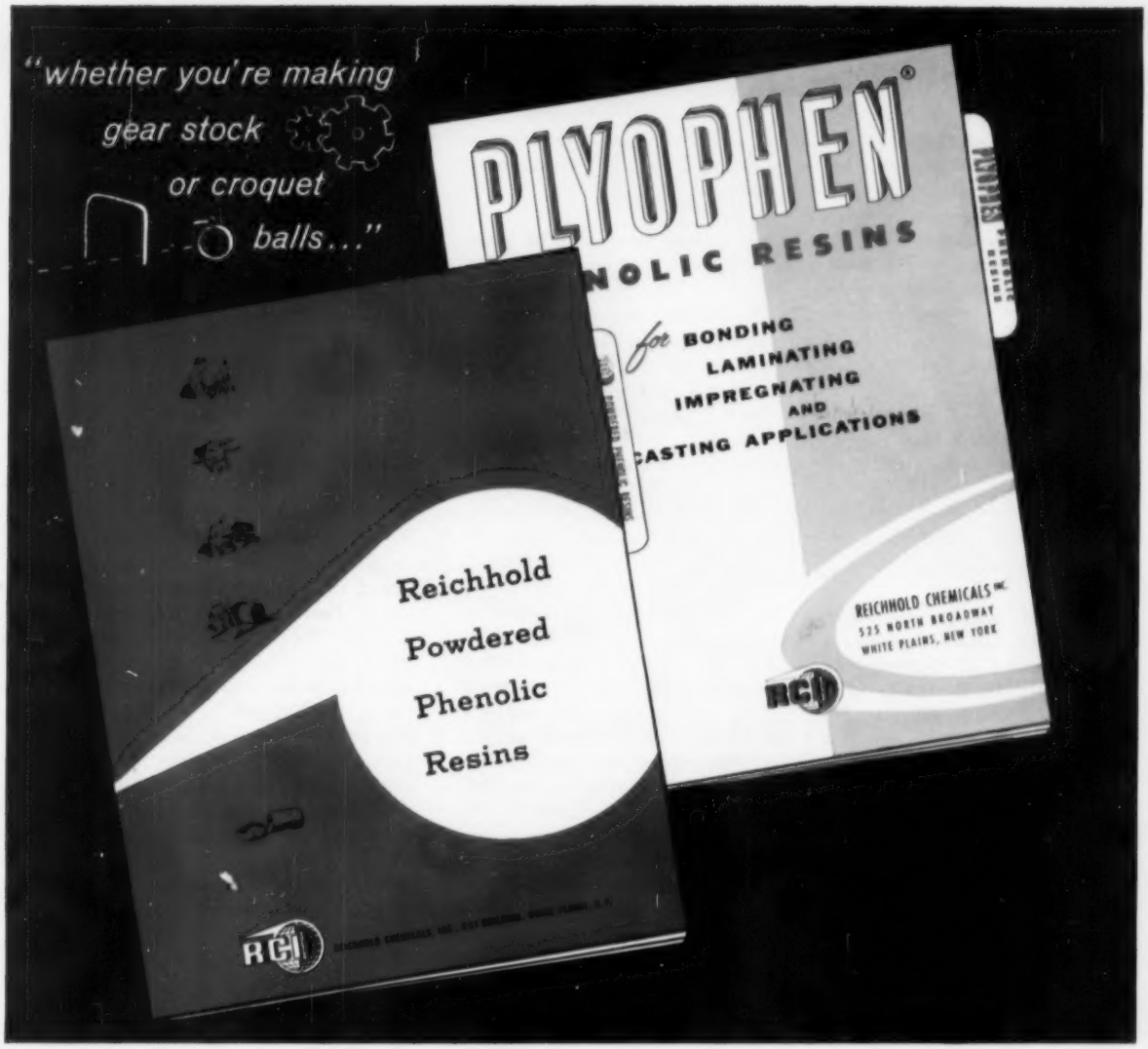

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profoundly affect the final product. Solutions of long-chain polymers can be gelled at concentrations as low as 0.5% by irradiation. The dosage needed to induce gel formation decreases with decreasing concentration, so that polymer molecules further apart in the solvent are apparently more readily linked together. The study of such polymer-solvent systems offers a useful method of comparing the mechanism of direct and indirect action, and a means of exploring the effect of polymer separation on the cross-linking process. It is also a useful tool in measuring the susceptibility of different chemical groupings to attack and may provide insight into the nature of solvent-polymer interactions.

Reaction of cellulose with dimethylol and monomethylolureas. R. Steele and L. E. Giddings, Jr. Ind. Eng. Chem. *48*, 110-14 (Jan. 1956). Monomethylolurea is monofunctional with respect to cellulose. When applied to either cotton or rayon with an acidic catalyst, it produces resin chains three or four urea residues long, which appear to be attached at one end to the main cellulose chains. It produces little crease recovery in cotton and rayon. Dimethylolurea and other resin precondensates with a formaldehyde-urea ratio of about 2 are difunctional with respect to cellulose. When applied to cellulose with an acidic catalyst, they react to form relatively short cross-links between the cellulose chains. On rayon with up to 5 or 6% resin content, this reaction produces only slightly greater crease recovery than the reaction of an equal amount of monomethylolurea; on cotton this cross-linking reaction is much more effective in crushproofing, even at low concentrations. The difference in the effectiveness of cross-linking resins at low concentrations, for crushproofing rayon and cotton, is probably due to the difference in the chemical accessibilities of these fibers. The reaction of urea-formaldehyde resins on cellulose occurs in two stages. The small degree of resinification that occurs takes place in the drying step, and reaction with the cellulose occurs during the subsequent cure at a higher temperature. Acid catalysts for urea-formaldehyde resins are used primarily to promote the reaction with cellulose rather than resinification.

Polyrubber: your pick of properties. D. R. Cannon. Chem. Eng. *62*, 142, 144, 146 (Nov. 1955). "Polyrubber" is a versatile polyurethane prepared at room temperature by adding an isocyanate catalyst to a polyester resin base. It can be made in a wide range of properties. Polyrubber can assume densities of 3 to 53 cu. ft./lb., have elongations of 0 to 300%, range from a hard material to one with a soft, open-cell structure much like foam rubber. Its chemical advantages over natural rubber include high resistance to temperature extremes (−40 to 300° F. without change), dilute acids, most solvents, oils, aromatic fuels, salt water, and sunlight. Since no plasticizers are required in Polyrubber formulations, resistance to oxidation is very high. Polyrubber can be molded into another piece of the same material to form a perfect joint having a tensile strength equal to any of its parts. Its uses include vibration damping, flooring, coatings for sand-blasting booths and marine decks, arm rests, and pump diaphragms. It is thought to have a future use in automobile tires, shoe soles, and airplane parts subject to supersonic erosion. Present cost is about 10 times that of uncompounded natural rubber, but in many instances the final cost of Polyrubber will be nearly equal to that of natural or synthetic rubber because of elimination of expense of additives, hot molds, extruders, presses, etc., and the extra labor involved.

Polyamides with uniform morphological structure. W. Hechelhammer. Kunststoffe *45*, 414-17 (Oct. 1955). Polyamides consist of amorphous and crystalline parts. The morphological structure of the commercially available resins is not uniform. To obtain a uniform structure test specimens were subjected to a heat treatment after they were molded. It was found that the critical temperature is 5 degrees C. above the melting point. The following data are given for an after-treatment of nylon: 4 min. at 218° C. gave uniform grain sizes below 1μ; 4 min. at 240° C. gave a completely uniform spherulite structure. In this way nylon parts having a predetermined uniform crystalline skin can be obtained. To what degree the properties of nylon are determined by other factors, such as stresses caused by cooling conditions, moisture content, and ratio of amorphous to crystalline material has not yet been determined.

Studies on ion exchange resins. XIV. Titration, capacity, and swelling of methacrylic acid resins. H. P. Gregor, M. J. Hamilton, J. Becher, and F. Bernstein. J. Phys. Chem. *59*, 874-81 (Sept. 1955). Titration curves of cross-linked polymethacrylic acid polymers are typical of those of polyacids. The polyacids are apparently weaker than their linear counterparts measured at the same salt concentration, reflecting the high Donnan concentration in the gel. When quaternary ammonium bases are used in place of alkali metal bases, there is a pronounced decrease in the average dissociation constant of the polyacids, which is presumed to be due to an increased chain potential resulting from the greater distance of closest approach with large gegenions. The swelling of the resins was larger with large gegenions, again indicative of a higher chain potential. Lithium and, to a lesser extent, sodium ions associate with the polyacid, as shown by swelling measurements.

Molding and fabricating

Static electricity and its effect. H. Haase. Kunststoffe *45*, 417-20 (Oct. 1955). In the past static electricity has been a somewhat neglected problem. With the increased use of plastics and synthetic fibers the mainly empirical preventive means of discharging the static are no longer sufficient. A new instrument, the "Statometer," measures the static electricity present in the plant.

(*To page* 262)

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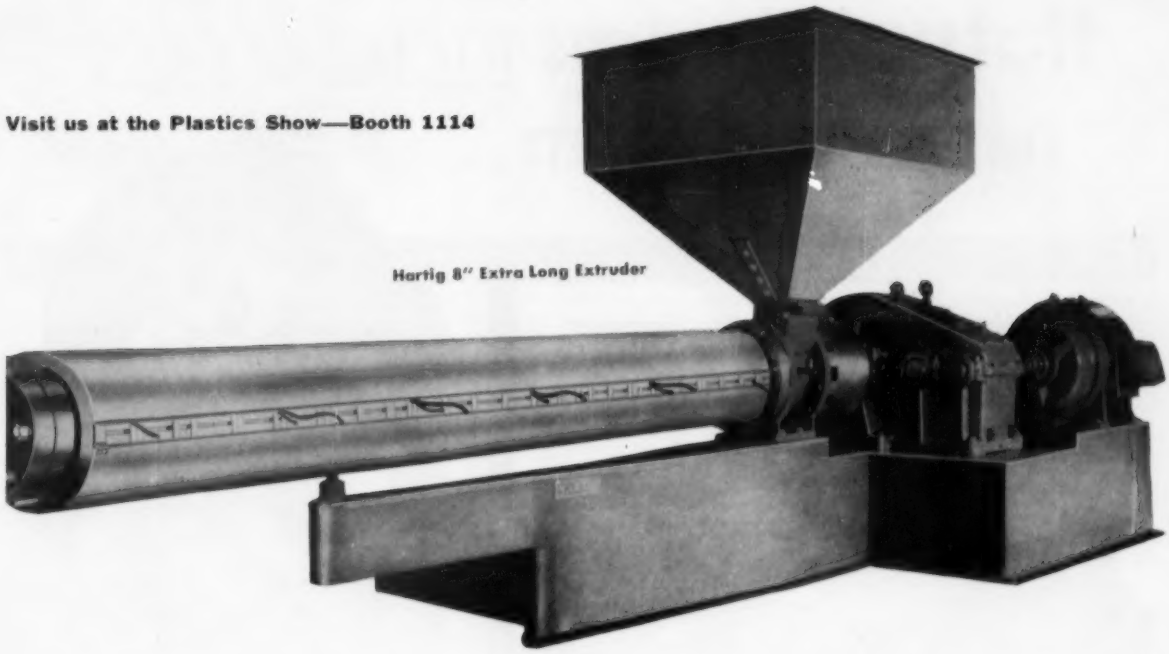

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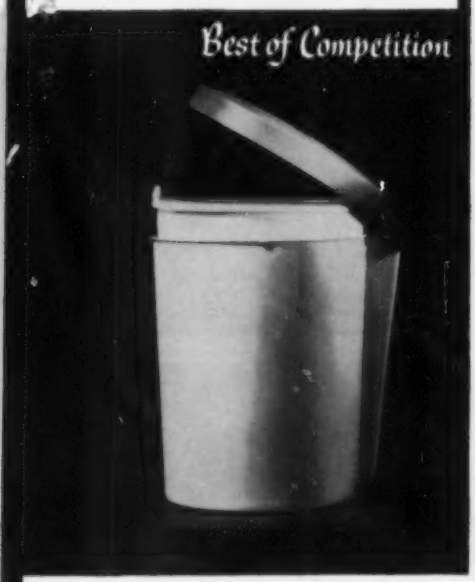

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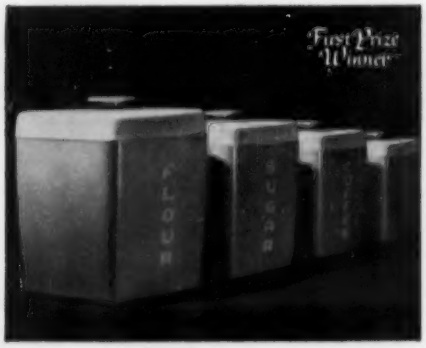

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Several other instruments are described that remove surface electricity. In certain cases the presence of static electricity is even desirable, such as in the removal of dust from gases in smokestacks to recover valuable raw materials, in flocking of textiles and plastics, and in separating lighter substances from heavier ones.

Coatings

Fluorocarbon dispersion coatings. G. Bartczak. Materials & Methods *42*, 90-95 (Nov. 1955). The unique combination of chemical, electrical, thermal, and mechanical characteristics of fluorocarbon plastics has become available as coatings. The nature of these coatings, their properties, their technique of use, and their applications are discussed. Fluorocarbon coatings fall into two general classes: the temporary (air-dried) type and the permanent (fused) type. Temporary or air-dried coatings consist of lower molecular-weight types of polychlorotrifluoroethylene which are applied from solvent solution, and which form the protective film by evaporation of the solvent at room temperature. The permanent or bake-on type fluorocarbon coatings are dispersions or suspensions of finely divided high polymer resins of either the tetrafluoroethylene or chlorinated fluorocarbon type in aqueous or organic solvent vehicle. After application by brush, dip, or spray, they are fused at high temperatures to provide optimum durability and chemical, thermal, and electrical resistance. The permanent type of coating is considered in detail. Teflon dispersions presently available include two primers (for steel and for aluminum), a one-coat enamel, a clear finish, and four colored enamels. All but the one-coat enamel must be applied over primers. Five chlorinated fluorocarbon dispersions are available for various methods of application. Materials to which fused fluorocarbon coatings are to be applied must be capable of withstanding fusing temperatures of 475 to 515° F. for chlorinated fluorocarbons and temperatures of 650 to 750° F. for Teflon coatings. Most ferrous and nonferrous alloys, glass, glass cloth, ceramic, and plated metals can be coated. Surfaces to be coated with fluorocarbon dispersions must be free of grease, dust, or organic matter, and must be lightly sandblasted or otherwise roughened in order to provide the necessary mechanical adherence.

Evaluating physical properties of coatings. J. I. Richardson. Chem. Eng. *62*, 242, 244, 248 (Nov. 1955). A coating that is to give dependable protection against corrosion must be resistant to the environment and must serve as a barrier between the environment and the underlying surface. Tests of chemical resistance alone are not enough to establish the effectiveness of a coating as a barrier. The coating must also meet standards of permeability, thickness, adhesion, flexibility, and abrasion resistance. Some of the

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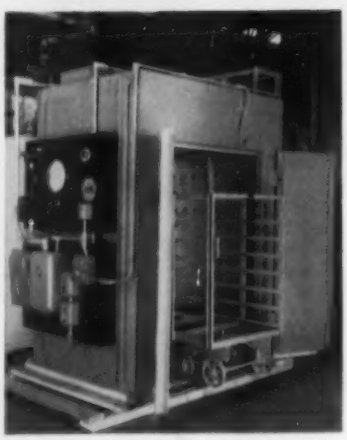

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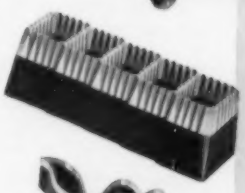

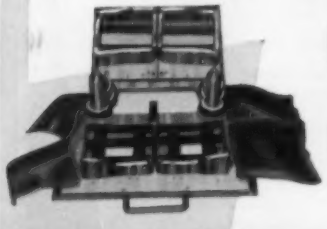

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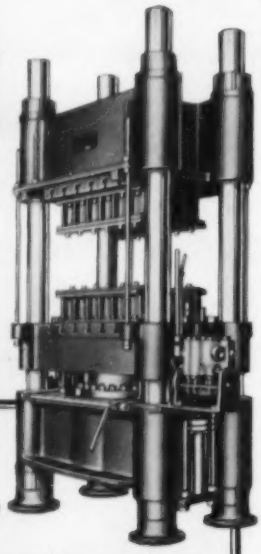

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more common methods for making these physical tests are briefly discussed.

Properties

Heat distortion temperature measurements for evaluation of thermoplastics. J. J. Gouza and W. F. Bartoe. Plastics Tech. *2*, 89-93 (Feb. 1956). An apparatus is described which complies with the requirements of the ASTM D648-45T Tentative Method of Test for "Heat Distortion Temperature of Plastics" and, in addition, possesses certain refinements in design and adaptability. The importance of instrumental factors and test specimen conditioning is briefly discussed. The effects of outer fiber stress on flexural deformation temperature are shown for heat resistant acrylic, cellulose acetate, vinyl chloride-acetate, modified acrylic, polyester, and allyl resins. The correlation of flexural deformation temperature with elevated temperature flexural and tensile strength values is shown for a heat-resistant acrylic, a modified acrylic, and a polyester. The use of flexural deformation temperature vs. stress data for predicting elevated temperature dimensional stability of formed parts is shown for heat resistant acrylic, modified acrylic, and polyester resins.

Toxicology of plastics and rubber. Plastomers and monomers. R. H. Wilson and W. E. McCormick. Ind. Medicine and Surgery *23*, 479-86 (Nov. 1954). The literature on the toxicology of resins, elastomers, plasticizers, stabilizers, and solvents is reviewed. Emphasis is placed on the products used in the plastics industry. The information available is meager in many instances.

The toxicology of synthetic resins. R. H. Wilson and W. E. McCormick. Ind. Medicine and Surgery *24*, 491-96 (Nov. 1955). Current literature on the toxicology of the various types of plastics is reviewed. The acrylic resins are inert substances, being used successfully as bone replacements, artificial eyes, and other prosthetic appliances. However, when placed in certain regions of the human body they should be used with caution because there is some evidence to show that tumor formation, tissue reaction, and sepsis can occur. Nylon can be implanted in the human body with little or no tissue reaction. Polyethylene is used safely in surgical repair, suture tubing, skull covering, plastic lung prosthesis, arterial reinforcement, and hernial repair. Polyethylene is used extensively as surgical repair material, both in and out of the body, with no apparent adverse effects. Occasional skin reactions have been reported. In general, it appears to be a perfectly safe, non-toxic, inert material. It does not change composition when it is autoclaved. Silicones are non-sensitizing and non-irritating. Polystyrene presents no health hazard from oral ingestion or skin contact, being inert and non-toxic. The vinyl resins are physiologically inert and have no toxic properties. They can be stored in the body

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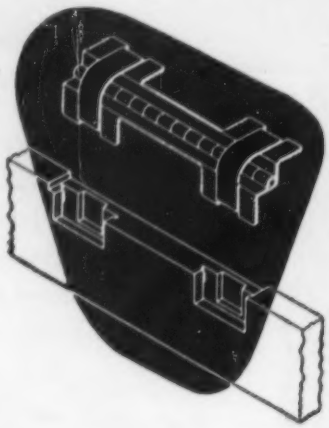

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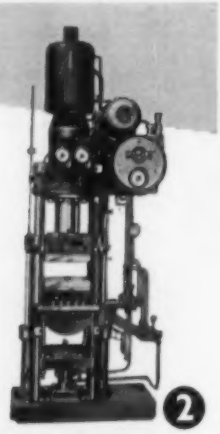

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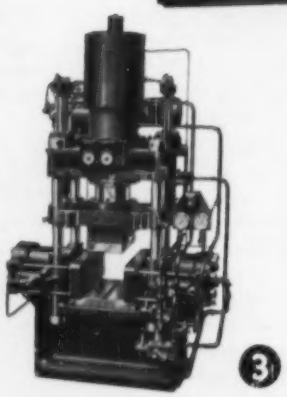

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and can be used for intravenous solutions. Most of the plastics are physiologically inert, non-toxic materials. Some are combinations of toxic compounds and in their preparation must be carefully handled. The industrialist planning on entering into the manufacture of plastic materials would be well advised to obtain the services of competent industrial hygiene, toxicology, and medical people to assist him in evaluating his materials physiologically and preventing occupational disease of his personnel.

Variation of photoelastic behavior with temperature for some polymers. K. Kawata. J. Polymer Sci. *19*, 359-64 (Feb. 1956). The variations of photoelastic behavior for styrene-divinylbenzene copolymers and a diallyl phthalate polymer were studied between 20 and about 190° C. The birefringences for constant stresses were measured. With suitably cross-linked polymers the transition from the glassy state to the rubber-like state was observed distinctly. In the higher temperature region the photoelastic behavior was in agreement with the statistical theory for ideal rubbers. The photoelastic coefficient in the entropy elasticity range varied linearly with increasing degree of cross-linkage. The extrapolated value of the stress optical coefficient for styrene copolymers to zero content of the cross-linking agent coincides with the value for polystyrene itself. With the very highly cross-linked polymer the transition was observed not to be distinct.

Friction of Teflon sliding on Teflon. D. G. Flom and N. T. Porile. J. Applied Phys. *26*, 1088-92 (Sept. 1955). The low coefficient of friction for Teflon sliding on Teflon is found to hold only if low sliding speeds and newly prepared surfaces are used. At high sliding speed, the nature of the surface is irreversibly changed such that subsequent sliding at low speed reveals a two-to threefold increase in the friction coefficient. In addition to the effect of high speed sliding, there are reversible changes in

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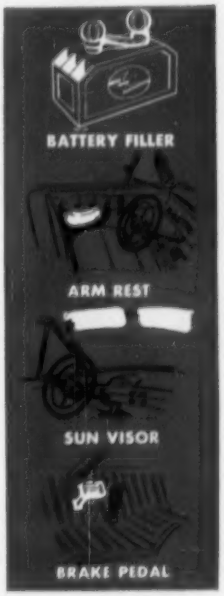

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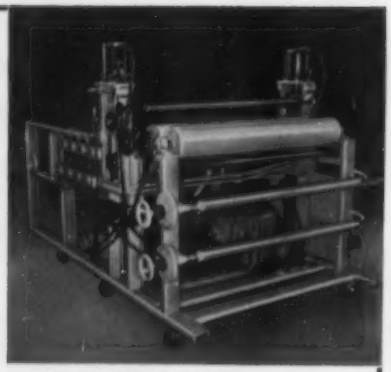

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the friction of Teflon on Teflon dependent in part on temperature. As the temperature of Teflon is increased from below room temperature, a sharp and pronounced increase in the coefficient of friction is observed in the vicinity of 20° C. The existence of a phase transition in Teflon at this temperature indicates a close correlation between the frictional and the structural properties of this material.

The nature of tensile rupture. I. J. Gruntfest. J. Polymer Sci. *18*, 449-54 (Dec. 1955). The problem of tensile failure is discussed in terms of the conditions for mechanical stability. Data are not available for detailed examination of the usefulness of this approach. However, some measurements on plasticized polyvinyl chloride, cellulose acetate, and polymethyl methacrylate suggest that the arguments may have some validity. The toughness and brittleness of materials are also considered briefly in the same terms. Attention is called to the complications that may arise from the adiabatic character of the failure process.

Measurement of the molecular weight of a polyester and evaluation of its molecular volume. H. L. Rosano. J. Colloid Sci. *10*, 362-69 (Aug. 1955). The micro- and macro-manometer techniques for the determination of molecular weight were applied to a polyester (m.w. = 4000). The polymer was studied in several solvents; the values obtained for the molecular weight are practically the same. However, the surface area occupied by one molecule is a function of the solvent. This result leads to the hypothesis that a molecule deposited on the surface is more or less spread out depending on the degree of solvation.

Applications

Extrusion and packaging. Canadian Plastics *1955*, 46-47, 49 (Nov.). The potential of the extruder in the field of packaging is discussed. The packaging industry is the largest consumer of extruded thermoplastic sheeting. The extruder continuously heats

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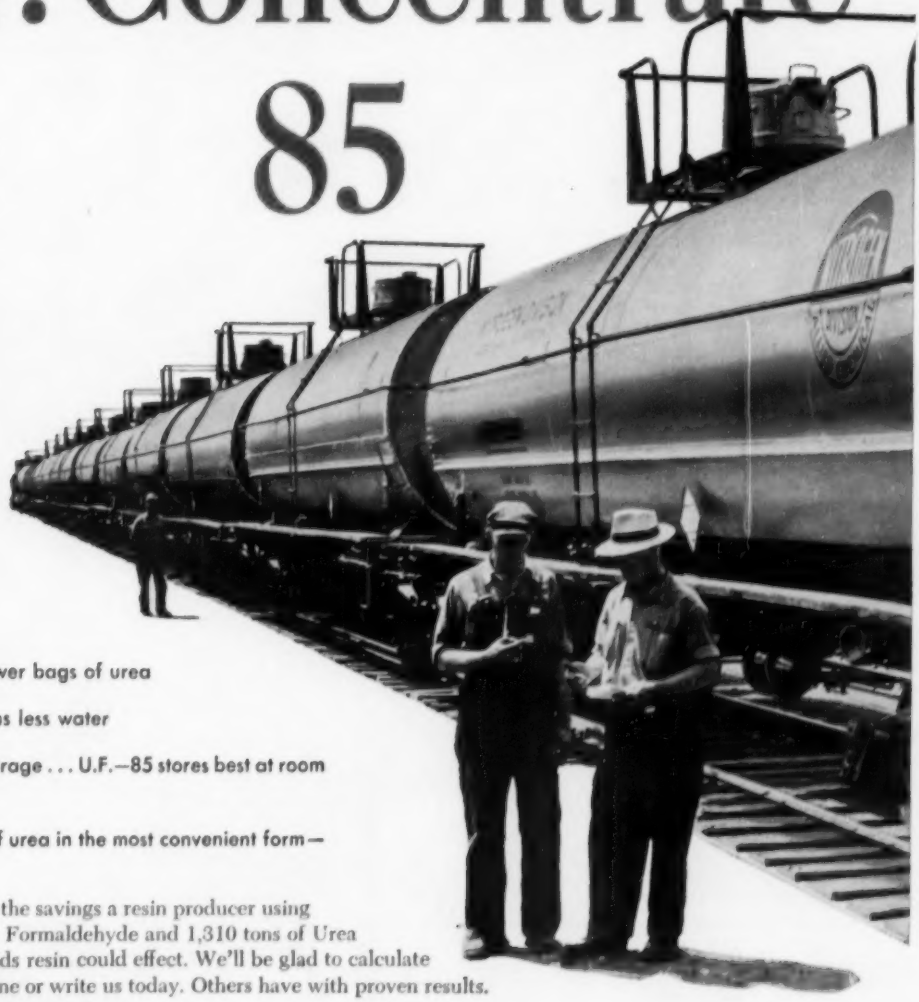

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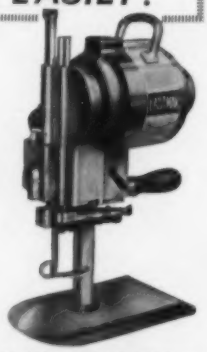

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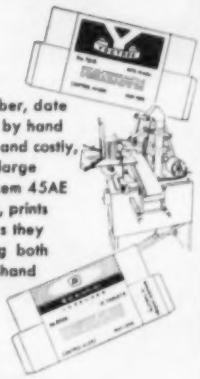

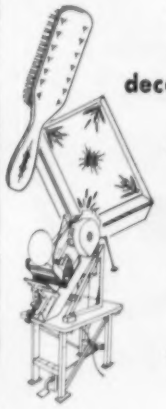

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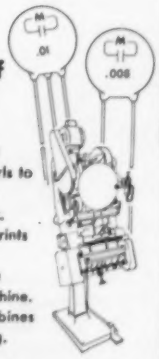

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Testing

On the determination of methyl content in polyethylenes. E. J. Slowinski, Jr., H. Walter, and R. L. Miller. J. Polymer Sci. *19*, 353-58 (Feb. 1956). A method for the quantitative determination of the degree of branching (methyl content) in ethylene polymers is described. This method involves the use of a calibration curve prepared from hydrocarbons of known methyl content. Because of the importance to the calibration of having hydrocarbon with a methyl content roughly that of the polymers to be measured, the hydrocarbon, n-$C_{17}H_{36}$, was prepared and its synthesis is given. The methyl contents of a series of polyethylenes, both commercial and experimental, were determined, and the results correlated with some physical properties of the polymers. A quantitative relationship is shown between the crystallinity of a

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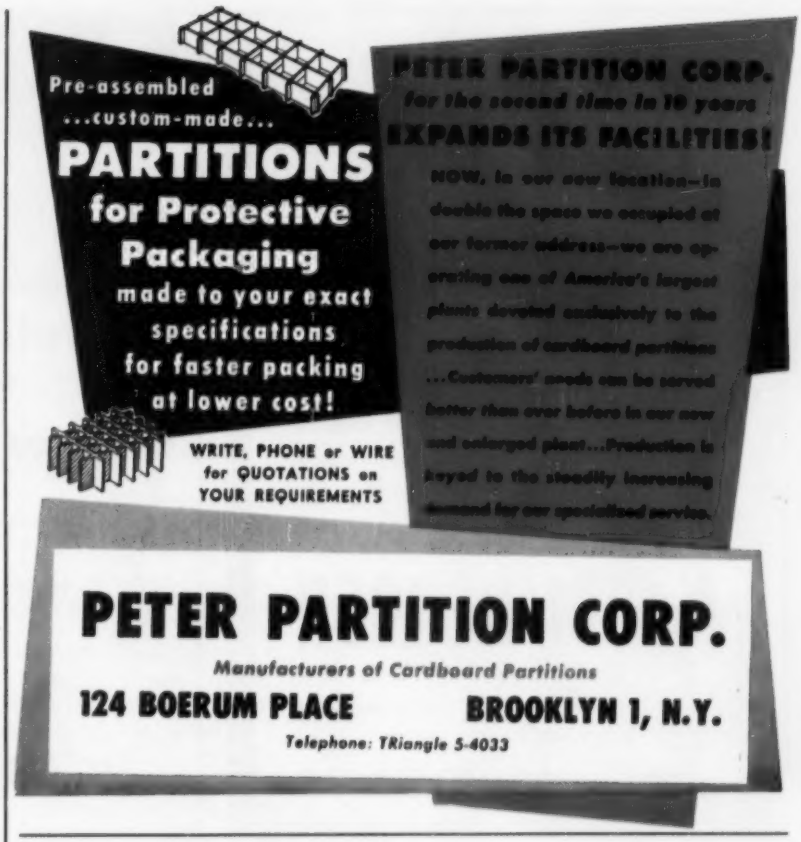
polymer, as measured by the density, and the degree of branching. Qualitative relationships between molecular weight and branching and between mechanical properties and branching are also shown.

Infra-red analysis of paint vehicles based on alkyd-nitrogen resin blends. C. D. Miller and O. D. Shreve. Analytical Chem. *28*, 200-01 (Feb. 1956). No satisfactory chemical method is available for estimating the urea-formaldehyde-melamine resin ratio in a paint vehicle comprising both of these in admixture with an alkyd resin. A method based on infra-red absorbance measurements at 5.8, 6.1, and 12.25 microns on thin vehicle films has provided a solution to this problem and affords a rapid means for estimating each individual resin component in typical two- and three-component alkyd-nitrogen resin blends. Results obtained on synthetic mixtures of known composition indicate a degree of accuracy and precision which is certainly sufficient for many practical applications.

Determination of methylol groups in phenolic resins. G. A. Steinmark and F. T. Weiss. Analytical Chem. *28*, 260-62 (Feb. 1956). An accurate and simple method for the determination of methylol groups in phenol-formaldehyde resins is described. Methylol groups and phenol condense in the presence of an acid catalyst to form water as one of the products. The water in the reaction mixture is titrated directly with Karl Fischer reagent and water produced in the reaction is calculated after correction for water in the sample and reagents. In contrast with previously available techniques, this method provides an accurate analysis using small quantities of sample, and thus facilitates examination of small scale laboratory preparations.

Chemistry

Acidity and polymerization activity of solid acid catalysts. O. Johnson. J. Phys. Chem. *59*, 827-31 (Sept. 1955). A method is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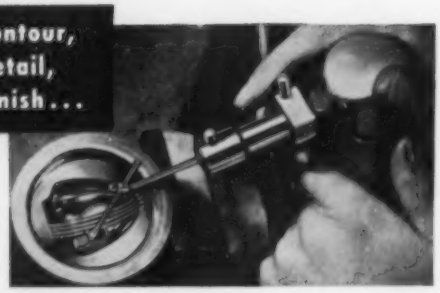

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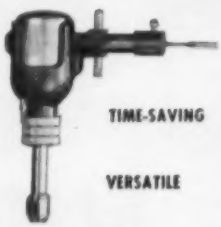

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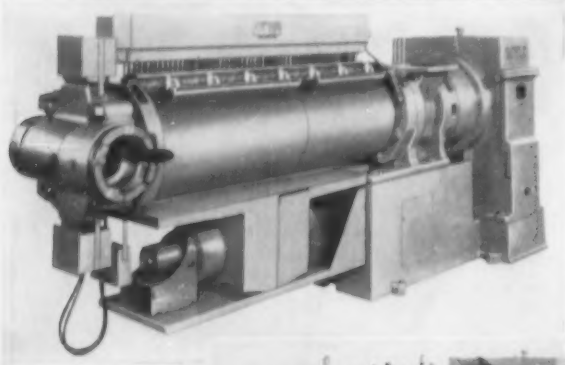

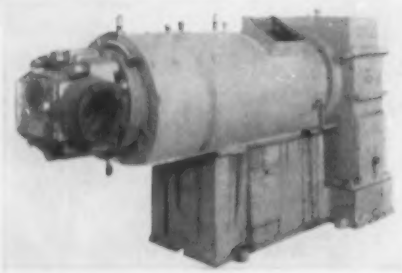

8½" Spirod extruder with side delivery head for jacketing. Up-graded from circulating type shown to the right.

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WRITE FOR LITERATURE

described for the determination of the acidity of solid surfaces. The results adequately measure acid sites on the solid catalyst that are important for polymerization of propylene at 200° C. The polymerization activity was observed to markedly increase with acid strength for a given number of acid sites.

Sulfinic acid derivatives as accelerators in the polymerization of methyl methacrylate. G. M. Brauer and F. R. Burns. J. Polymer Sci. *19*, 311-21 (Feb. 1956). A study was made of the efficiency of amine salts of *p*-toluenesulfinic acid as accelerators in the polymerization of methyl methacrylate. These compounds are readily synthesized by addition of amine to the ether solution of the sulfinic acid. Most of the salts are stable in air. Salts of secondary and tertiary aromatic amines, such as the methylaniline or dimethyl-*p*-toluidine salts, are very efficient accelerators in the benzoyl peroxide-initiated polymerization. However, colored products are formed. Aliphatic amine salts as well as the free acid give colorless polymers, but the setting time is increased considerably. Heterocyclic amines show reduced activity as polymerization accelerators.

Publishers' addresses

Analytical Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

Canadian Plastics: Monetary Times Printing Co., Ltd., 341 Church St., Toronto 2, Ontario, Canada.

Chemical Engineering: McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 18, N. Y.

Chemical Engineering Progress: American Institute of Chemical Engineers, 120 E. 41st St., New York 17, N. Y.

Industrial and Engineering Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

Industrial Medicine and Surgery: Industrial Medicine Publishing Co., 605 N. Michigan Ave., Chicago 11, Ill.

Journal of Applied Physics: American Institute of Physics, 57 E. 55th St., New York 22, N. Y.

Journal of Colloid Science: Academic Press, Inc., 125 E. 23rd St., New York, N. Y.

Journal of Physical Chemistry: American Chemical Society, 1115 Sixteenth St., N. W. Washington 6, D. C.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.

Kunststoffe: Karl Hanser Verlag, Leonhard-Eck-Strasse 7, Munich 27, Germany.

Materials and Methods: Reinhold Publishing Corp., 430 Park Ave., New York 22, N. Y.

Plastics Technology: Bill Brothers Publishing Corp., 386 Fourth Ave., New York 16, N. Y.

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See Page **33** *for Illustration of Coordinated Robbins Sheet Making Equipment*

U.S. Plastics Patents

Copies of these patents are available from the U. S. Patent Office, Washington, D. C., at 25¢ each

Olefin resins. W. C. Smith and R. M. Thomas (to Esso). U. S. 2,734,047, Feb. 7. Olefin polymerization.

Polyvinyl alcohol. J. E. Bristol and W. B. Tanner (to Du Pont). U. S. 2,734,048, Feb. 7. Production of polyvinyl alcohol.

Extrusion. T. W. Winstead (to Hedwin). U. S. 2,734,224, Feb. 14. Extrusion die.

Mold. A. J. Costick and W. A. Jones (to Goodyear). U. S. 2,734,227, Feb. 14. Mold for porous plastic.

Resins. T. F. Bradley (to Shell). U. S. 2,734,877, Feb. 14. Alkyd resins modified with substituted carboxylic acids.

Varnishes. S. Robbins and R. H. Runk (to Westinghouse). U. S. 2,734,878, Feb. 14. Air-drying varnishes from oil-soluble phenolic resins.

Copolymer. H. Ehring and K. Raichle (to Farbenfabriken Bayer). U. S. 2,734,880, Feb. 14. Copolymer of vinyl aromatic hydrocarbon, and alkyd resin.

Resins. R. E. Lally and R. J. O'Hara (to Ferro). U. S. 2,734,881, Feb. 14. Stabilized polyvinyl chloride.

Plastics. P. V. Smith, Jr. and D. W. Young (to Esso). U. S. 2,734,884, Feb. 14. Composition of polyvinyl chloride and an alkyl ester of an unsaturated acid.

Polymer. G. F. D'Alelio (to Koppers). U. S. 2,734,888, Feb. 14. Dye-receptive polyacrylonitrile.

Polymers. S. Melamed (to Rohm & Haas). U. S. 2,734,891, Feb. 14. Polymers of unsaturated ureido ethers.

Curing. M. F. Vaughan (to Distillers). U. S. 2,734,894, Feb. 14. Curing 2,4-dimethylstyrene polymers.

Sheet. G. T. Scheldahl (to Herb-Shelly). U. S. 2,735,475, Feb. 21. Welding large thermoplastic sheets.

Pipe connector. W. H. Chadbourne (to Danielson Manufacturing). U. S. 2,735,699, Feb. 21. Snap fit plastic pipe connector.

Molding compound. G. C. DeCroes and J. W. Tamblyn (to Eastman Kodak). U. S. 2,735,782-3. Cellulose acetate butyrate composition.

Coated fabric. A. F. Schramm, Jr. U. S. 2,735,786, Feb. 21. Resin-coated fabric.

Polymers. A. D. F. Toy and K. H. Rattenbury (to Victor). U. S. 2,735,789, Feb. 21. Brominated phosphonate polymers.

Sheet. G. T. Scheldahl (to Herb-Shelly). U. S. 2,735,797, Feb. 21. Heat-sealing and severing plastic sheets.

Coating. B. H. Kress (to Allied Chemical). U. S. 2,735,825, Feb. 21. Silicone-alkyd coating.

Resin. R. M. Frey (to McGraw Electric). U. S. 2,735,826, Feb. 21. Furan resin-tall oil reaction product.

Copolymers. M. L. A. Fluchaire and J. A. Phelisse (to Société des Usines Chimiques). U. S. 2,735,827, Feb. 21. Acrylonitrile copolymers.

Polymerization. H. W. Coover, Jr. (to Eastman Kodak). U. S. 2,735,830-1, Feb. 21. Polymerization of acrylonitrile.

Resins. J. E. Wicklatz and J. F. Howe (to Phillips). U. S. 2,735,832, Feb. 21. Sulfur dioxide resins.

Polymers. G. W. Stanton and F. A. Ehlers (to Dow). U. S. 2,735,833-4, Feb. 21. Acrylonitrile polymers stabilized with carbamates.

Resins. J. E. Wicklatz and J. F. Howe (to Phillips). U. S. 2,735,835-6, Feb. 21. Unsaturated sulfur dioxide resins.

Interpolymers. L. M. Minsk, D. D. Reynolds, J. L. R. Williams (to Eastman Kodak). U. S. 2,735,837, Feb. 21. Interpolymer of 2,5-diacetoxystyrene.

Resinous condensate. R. Dijkstra and J. de Jonge (to Hartford National Bank). U. S. 2,735,838, Feb. 21. Resinous phenolic condensate.

Polymerization. H. A. Schrenk and R. T. Lynch (to American Enka). U. S. 2,735,839-40, Feb. 21. Polymerization of lactams.

Polymers. C. F. H. Allen and L. M. Minsk (to Eastman Kodak). U. S. 2,735,841, Feb. 21. Sulfinic acids of aromatic polymers.

Polymers. M. L. A. Fluchaire and J. A. Phelisse (to Société des Usines Chimiques). U. S. 2,735,842, Feb. 21. Vinyl amino ether polymers.

Film. H. A. Toulmin, Jr. (to Commonwealth Engineering). U. S. 2,736,056, Feb. 28. Forming plastic film and printing it.

Polyamides. W. J. Davis and D. B. Koch (to Polymer). U. S. 2,736,057, Feb. 28. Elongated shapes from polyamides.

Extrusion. A. F. Dellheim (to National Plastic Products). U. S. 2,736,058, Feb. 28. Extrusion apparatus.

Extrusion. L. C. Rubin (to M. W. Kellogg). U. S. 2,736,064, Feb. 28. Extrusion molding of perfluorochlorocarbon plastics.

Film casting. W. A. Chren and C. F. Hofrichter (to Du Pont). U. S. 2,736,066, Feb. 28. Film casting of molten thermoplastics.

Shell molding. K. M. Bartlett (to Thompson Products). U. S. 2,736,077, Feb. 28. Shell mold components.

Coating. A. W. Allen. U. S. 2,736,289, Feb. 28. Apparatus for applying plastic coating to yarns.

Coating. T. F. Bradley and R. W. H. Tess (to Shell). U. S. 2,736,664, Feb. 28. Coating containing polyhydric alcohol esters of rosin.

Laminates. A. S. Kidwell (to Connecticut Hard Rubber). U. S. 2,736,680, Feb. 28. Laminated fluorocarbon polymers.

Condensate. H. G. Smith, T. L. Cantrell, and J. G. Peters (to Gulf). U. S. 2,736,702-3, Feb. 28. Condensates of formaldehyde, alkaline earth metal sulfide, and an alkylated phenol.

Polymers. A. J. Lowe and D. Butler (to Oxirane). U. S. 2,736,716, Feb. 28. Polymers of styrene and unsaturated fatty compounds.

Copolymers. C. Frazier (to American Cyanamid). U. S. 2,736,717, Feb. 28. Copolymers of vinyl aromatic compounds.

Resin. C. S. Webber (to Norton). U. S. 2,736,718, Feb. 28. Rapid curing phenolic adhesive.

Elastic material. A. S. Kidwell (to Connecticut Hard Rubber). U. S. 2,736,720, Feb. 28. Fuel-resistant halogenated polydimethylsiloxanes.

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New Machinery and Equipment

Novel extruders

A new plastics extruder incorporates a very short heating zone at the front of the screw, a short hollow screw, and a plunger inside the screw. Since most of the screw length is used only to convey material in granular form, the Autoflow 100H requires only a 5-hp. motor to extrude 100 lb./hr. The material is under heat for a relatively short time in the front portion of the screw, a feature particularly important in the extrusion of heat-sensitive materials such as unplasticized PVC. It operates as follows: The feed material is conveyed by the flights on the hollow screw up to a heated-cone baffle. The material is plasticated by the milling action of the tapered flights on the front end of the screw against the baffle. Material then extrudes internally through a series of ports at the front end of the screw into a cavity ahead of the plunger inside the screw. It then extrudes out through the die. The plunger acts as a damper and is activated by an automatically controlled compressed air supply. The damping action is said to smooth fluctuations caused by the screw flights and to produce a more uniform product. By positioning the plunger in respect to the number of ports, any number of ports may be left open; the fewer ports left open, the more intensive is the milling action. This variable-action feature is said to give the extruder the ability to handle many different thermoplastic materials with only one screw. Breaker plates and screen packs are unnecessary. *Reed-Prentice Corp., Worcester 4, Mass.*

Take-off and cutter. Splicer

Refrigerator gaskets, window channels, and other non-symmetrical shapes of flexible vinyl and similar materials may be cut continuously on a new take-off and cutting machine. A specially designed take-off arrangement prevents material from buckling and is said to give control of length to within 1/32 in. on lengths from 2 in. up. The cutting cycle may be varied from 1/15 of a sec. to 4 min.; feed speeds from 2 to 170 ft./min. are possible. Up to three timers may be installed in the control circuit so that it is possible to cut three different lengths in sequence.

Butt-splicing of refrigerator gaskets and similar products is carried out semi-automatically by a new splicing machine. Pressure on the gaskets, heating cycle, and applied wattage are all automatically controlled by the machine. It can be supplied with one or two heads and is furnished with appropriate fixtures for holding the pieces to be spliced. *Robbins Plastic Machinery Corp., 1430 Mishawaka St., Elkhart, Ind.*

Round-knife machine

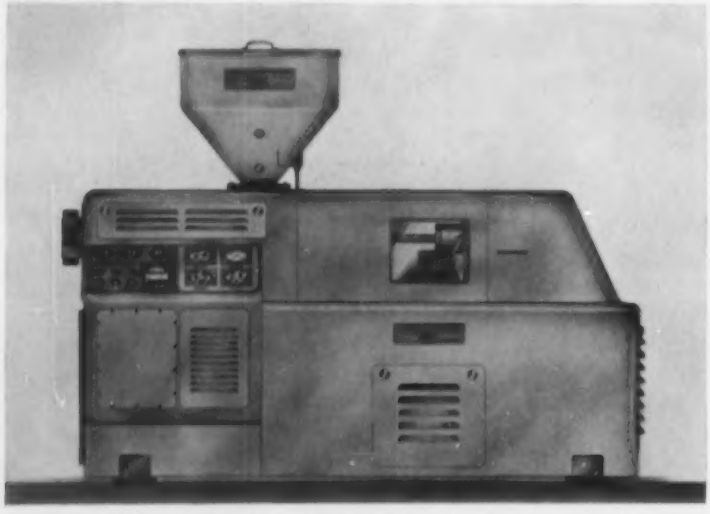
The "Lightning" models, a new series of cloth cutting machines, incorporate several major improvements including the following: permanently lubricated motor bearings, a metal cap that seals the gears against lint and dust, a fully enclosed housing around the automatic starter, and a forward sweep plow that keeps threads and loosely woven materials from getting behind the knife.

The series is available in various motor powers, knife sizes, and gear ratios. The new knives are said to make possible higher production and lower maintenance and operating costs. *Eastman Machine Co., 779 Washington St., Buffalo 3, N. Y.*

Small injection machine

A ¾-oz. injection machine that can plasticate material at a rate of up to 10 lb./hr. has a hydraulic system which is extremely simple and economical, requiring only a 3-hp. motor. The "Thomas" machine has a mold space of 9 by 10 in. with a maximum mold opening of 6 inches. Top clamping force is 30 tons and top injection pressure is 15,000 p.s.i. The hydraulic pump (really two pumps in one) closes the mold at low pressure then clamps with high pressure in the same stroke. A safety device

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.



Reed-Prentice 100H extruder incorporates a short heating zone at front of screw and a plunger located inside a short screw

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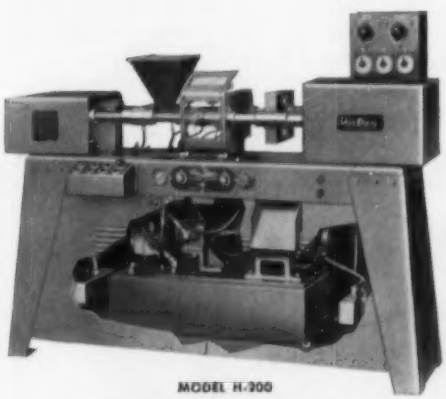
MODEL H-250



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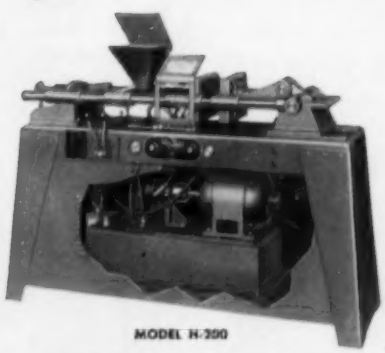

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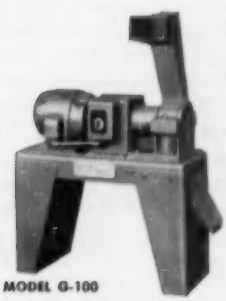

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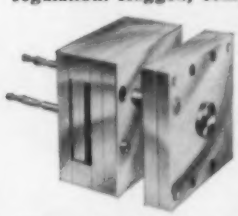

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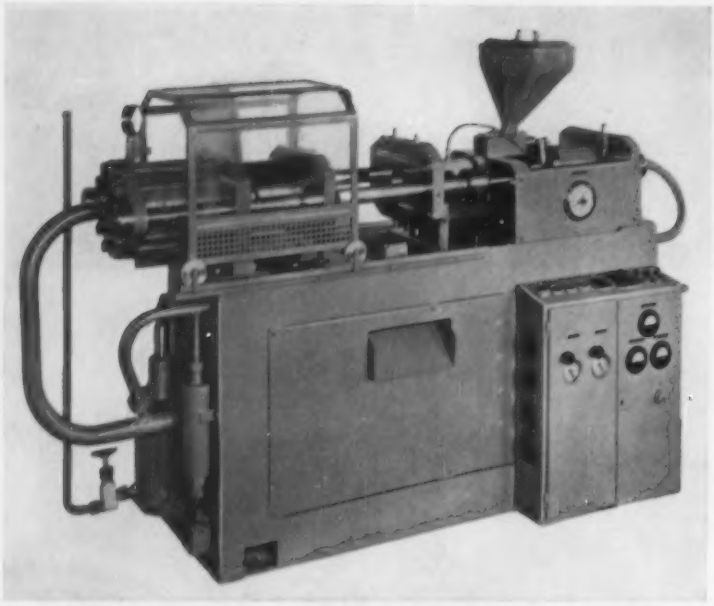


Newark Die ¾-oz. injection machine for testing, training, and short runs requires only a 3-hp. motor for its hydraulic system

keeps the mold from closing if there is any obstruction. The machine is said to be ideally suited to laboratory work, training purposes, testing of various types of molds, and economical production of pieces on short runs. *Newark Die Co., 24 Scott St., Newark 2, N. J.*

Cutter for coated fabric

A new cutter automatically measures, cuts, conveys, and stacks vinyl-coated fabrics. The machine accurately handles materials up to 60 in. wide and lengths 6 ft. long can be cut at the rate of 14 per minute. The cutter is said to function best when installed in-line with other machines, e.g., extruders or laminators, and can also handle materials from rolls. *Hobbs Mfg. Co., 26 Salisbury St., Worcester, Mass.*

Embossing machine

The new Liberty embosser has 10 heater rolls and can process webs at speeds up to 35 yd./min. The machine is provided with a Link-Belt system giving fully automatic control of web tension. Tension-controlled clutches wind up the embossed web with or without tension as desired. This arrangement is said to result in improved dimensional stability of the embossed material. The new machine also has available higher pressure on the embossing head than did its predecessor. *Liberty Machine Co., 275 Fourth Ave., Paterson, N. J.*

Injection molding machine

Model 616-L-12 injection molding machine, the latest development in the Lewis "6" series has been completely redesigned for higher production capacities. The machine dry-cycles in 10 sec., plasticates 100 lb./hr. of material, and can shoot 12 oz. of polystyrene with prepacking. It will accommodate molds measuring 14½ by 24 in. mounted either vertically or horizontally. Maximum clamping force is 200 tons, maximum injection pressure is 21,000 p.s.i. *Lewis Welding & Engineering Corp., 23002 St. Clair Ave., Cleveland 17, Ohio.*

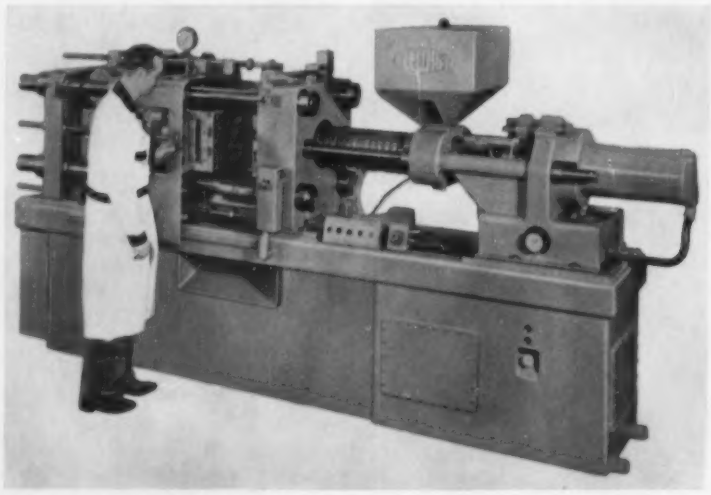
Continuous packaging machine

The Mercury accomplishes continuous automatic packaging through the lamination of two sheets of clear plastic at speeds of 5 to 20 ft./min. The machine automatically inserts the product being packaged; heat-seals, prints, and trims individual packages; or rewinds the packaged product in a continuous ribbon. Maximum roll width is 14 inches. Several ribbons can be processed at the same time. *Comet Industries, 9865 Franklin Ave., Franklin Park, Ill.*

8-oz. injection machine

Dry-cycling in less than 8 sec., a new 8- to 10-oz. injection machine Model 275T is 60% faster than the earlier model it replaces. New cylinder design has increased plasticating capacity to 120 lb./hr., while the injection capacity may be increased to 10 oz. or more by stuffing. Injection speed ranges from 79 to 148 in./min. with a top injection rate of 800 cu. in./min.

(*To page* 287)



Lewis Welding Model 616-L-12 injection machine dry-cycles in 10 sec., can accommodate molds mounted vertically and horizontally

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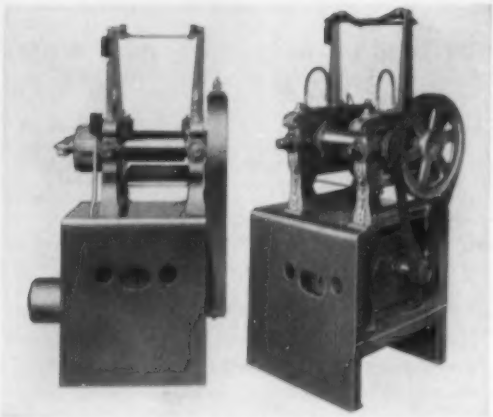
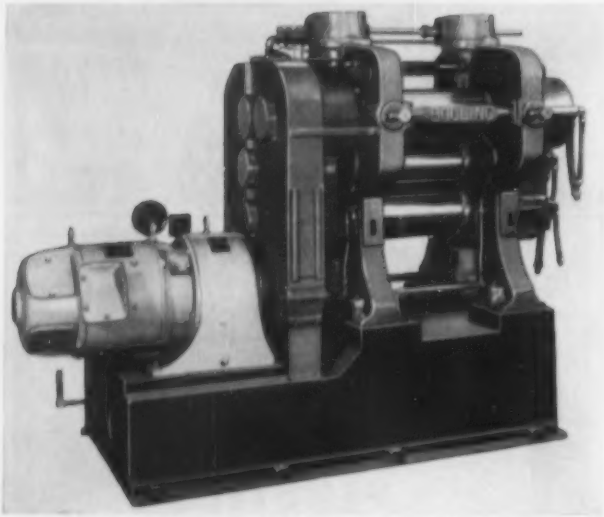
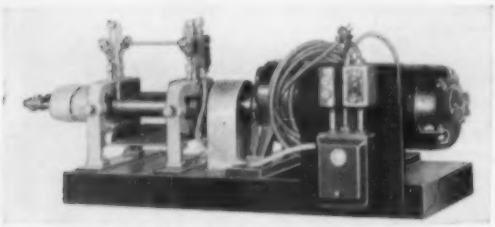


No. 0—6" x 12" mill, standard model

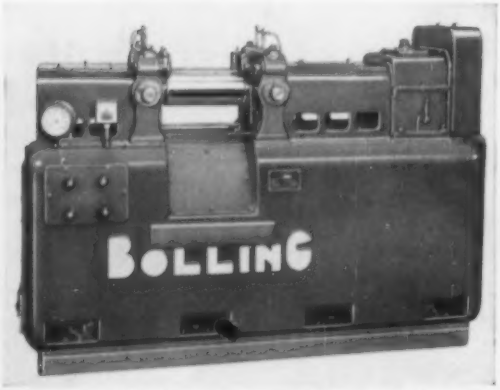


No. 1—8" x 16" 4-roll (or 3-roll) calender



No. 00—2½" x 7" midget mill

150-ton 36" x 36" transfer molding press



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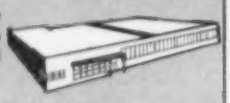

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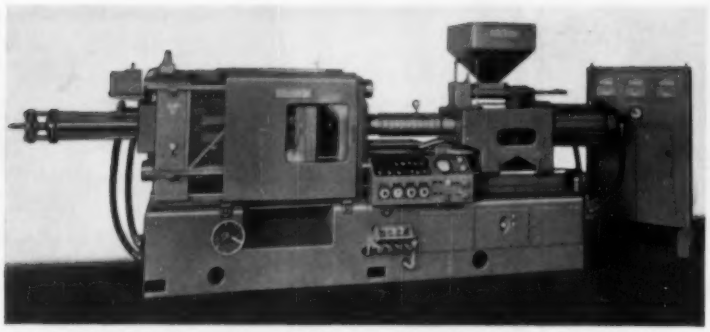


Reed-Prentice 8- to 10-oz. injection machine Model 275T is reported to be 60% faster than the earlier model that it replaces

The mold clamping stroke is adjustable between 6¼ and 10¼ in., and maximum clamping force is 275 tons. Platens measure 22½ by 25 in., with 11¼ by 14¼ in. between the bars. A low-pressure die closing unit, which protects the mold by stopping the machine in case a molded part fails to eject, is optional equipment. *Reed-Prentice Corp., Worcester 4, Mass.*

Plastics granulator

The M-300, the third in the series of Marvel plastics granulators, is the largest so far. It has a grinding capacity of up to 400 lb./hr. and can handle even the softer materials such as polyethylene. The double-shear knife action is claimed to eliminate fluffing. Hot and cold sprues can be fed simultaneously and the large 8- by 16-in. throat opening can accommodate large-area rejects. While positive locking of the hopper to the grinder is assured, it can nevertheless be detached in seconds to expose the entire inside of the machine for cleaning. The collection bin is equipped with a large sight glass. *Ball & Jewell Inc., 24 Franklin St., Brooklyn, N. Y.*

Release agent

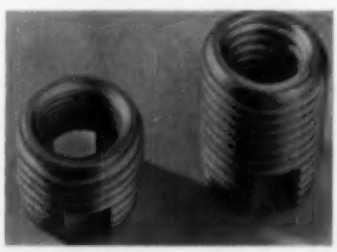
Release-Cote prevents coatings of plastics, glues, paints, and inks from adhering to the walls of pots, ink fountains, spray booths, tanks, or any other exposed surface, and is claimed to cut clean-up time in half. The compound is "fire-safe" and will not mix with coating materials. It is easy to apply with a rag, a brush, or with spray equipment. After operating equipment has been drained of tacky substances the residue is easily and quickly removed. The release agent can also be rubbed on worker's hands to prevent coating materials from sticking to the skin and nails. It washes off easily. *Potdevin Machine Co., 285 North St., Teterboro, N. J.*

Stamping press

The toggles of the new Peerless stamping press have three times the strength of the old ones and the ram has been made heavier to eliminate twisting during the making of impressions. The table can be lowered further to permit stamping of articles 2½ in. thicker than before. *Peerless Roll Leaf Co., Inc., 4511 New York Avenue, Union City, N. J.*

Short threaded inserts

A series of short Tap-Lok inserts has been developed for use in sections too thin for the regular-length inserts. They, like the regulars, are used where excessive thread wear would be suffered if threads were cut directly into a soft base plastic (or light metal alloy). Whereas the regular in-



Groov-Pin short inserts for use on sections too thin for regular lengths

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. . easiest-to-clean unit on the market!

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2 reversible bed knives
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Height ..... 52½ inches
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serts have a length-to-diameter ratio of about 1.5, the short series have lengths equal to their diameters. They are available in hardened steel, stainless, and brass. *Groov-Pin Corp., 1128 Hendricks Causeway, Ridgefield, N. J.*

Portable elevator

The new Portelevator line offers greater capacities in all styles. The "15" and "25," lifting 1500 and 2500 lb. respectively, supplant old styles "O" and "A." Other units of the line now include the "35," the "50," and the "50-6," of which the "35" and "50-6" are new additions. These models have a six-wheel base which reduces the effort needed to move the lead table from place to place and facilitates turning. Available as accessories are an oversize, demountable top plate and an extra-long, roller-conveyor top. *Hamilton Tool Co., 917 Hanover St., Hamilton, Ohio.*

Injection molding machine

A new 2¾-oz. injection machine will shoot up to 5 oz. with prepacking. Its plasticating rate is 30 lb./hr. and the machine has up to 15-oz. capacity in the heating chamber. It will hold molds up to 12 by 12 in. and from 4 to 12 in. thick. Offered in two models (356 and 356A, which develop 20,000 and 10,000 p.s.i. stock pressure respectively) the machines can be operated manually or automatically. The dry cycle time is about 9 sec. for Model 356 and 6 sec. for Model 356A. Over-all dimensions of both machines are: length, 84 in.; width, 26 in.; height, 62 in.; maximum daylight opening, 6¾ inches. *Clifton Hydraulic Press Co., 287 Allwood Rd., Clifton, N. J.*

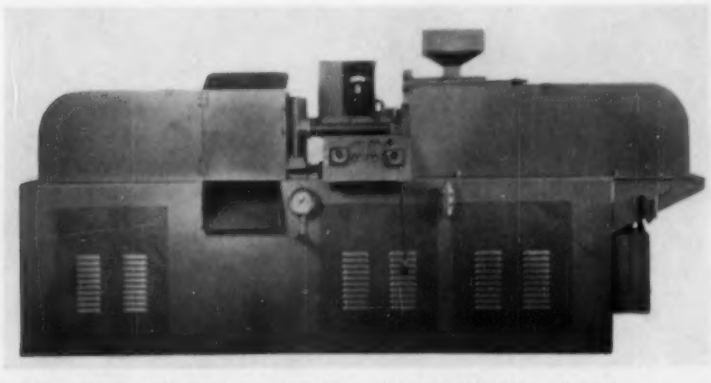
Multiple chamber reactor

Designed to give good control of exo- and endothermic polymerization reactions, a multi-chamber reactor somewhat resembles a plate-and-frame filter press in construction. The reaction volume is divided into many slab-like sections separated by metal platens. Heat-transfer media may be circulated through the platens. The large area-to-volume ratio gives much better control than can be obtained in a cylindrical vessel of equal volume containing equally viscous masses. When polymerization is complete, the reactor is opened and the polymer slabs, in convenient form for size reduction, are removed. The reactor is available in slab thicknesses from 1 to 5 in., with any desired number of chambers in sizes from 12 to 56 in. square. *T. Shriver & Co., Inc., 808 Hamilton St., Harrison, N. J.*

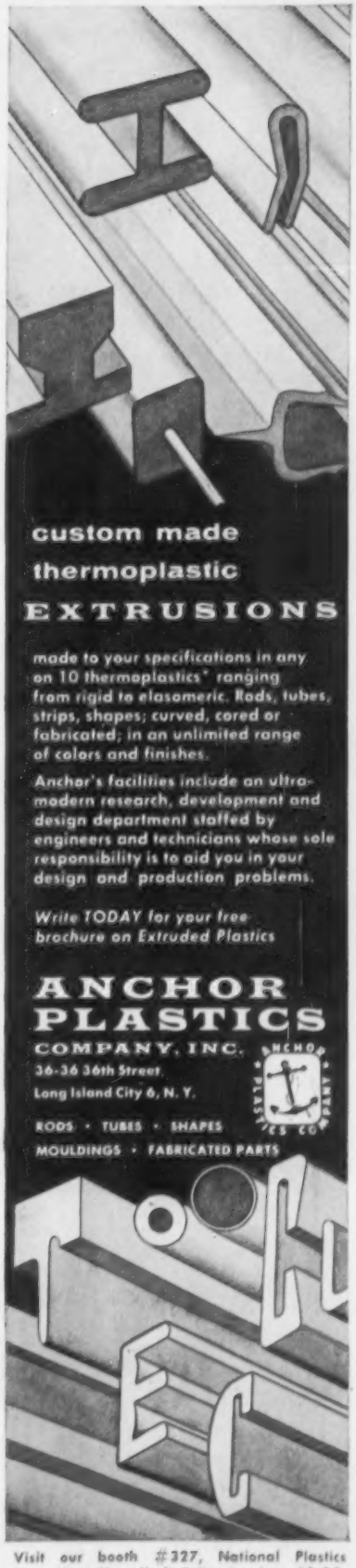
Pipe take-off

Production of rigid PVC pipe is said to be simplified by a new cooling and take-off machine. The cooled pipe is held by four jaws fitted with eight concave rollers. The rollers are covered with a high-friction material and springs can be adjusted to give the desired traction. The take-off speed may be varied continuously over the range of 6.7 to 40 in./

(*To page* 293)



Clifton Hydraulic 2¾-oz. injection machine Models 356 and 356A develop 20,000 and 10,000 p.s.i. stock pressure respectively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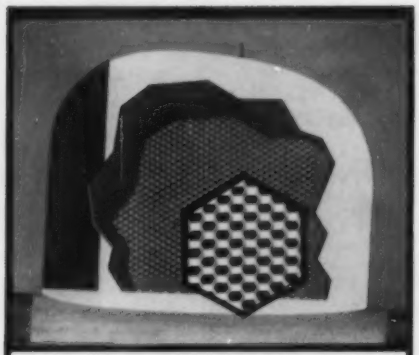

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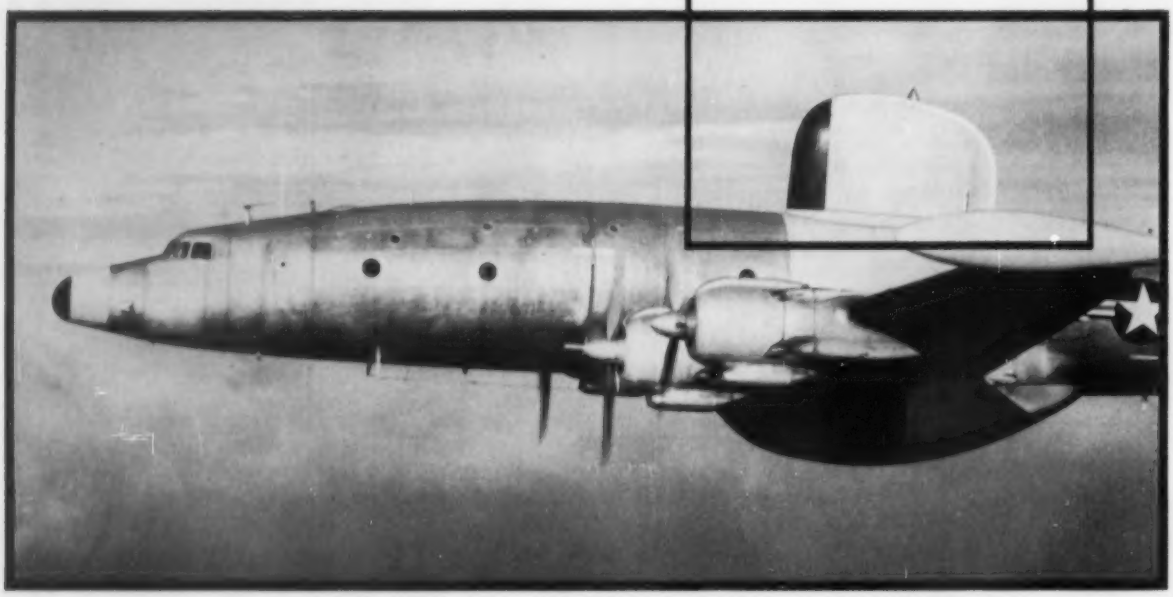

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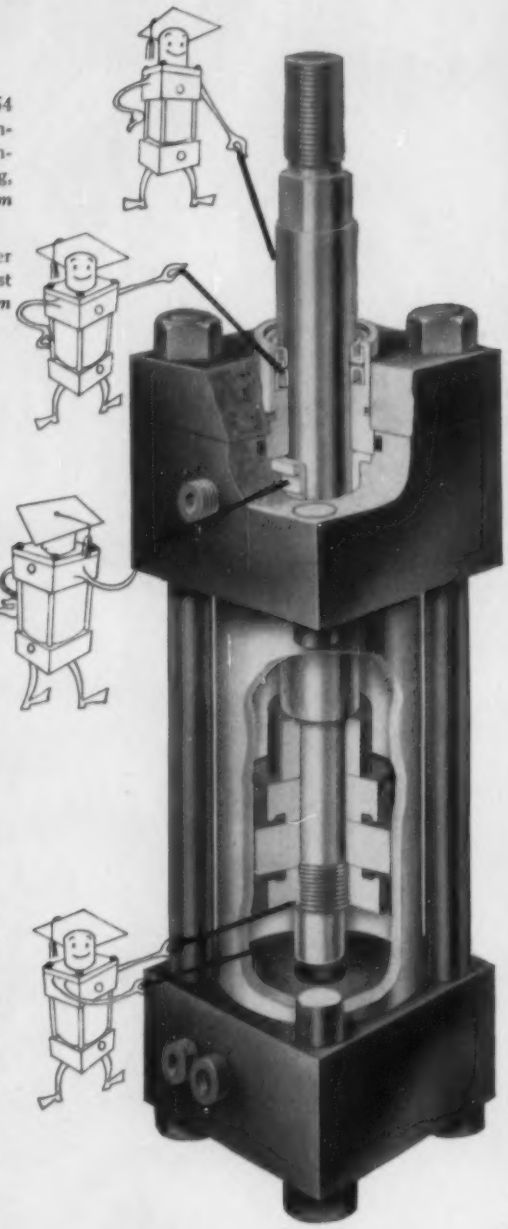

NOTE. On all Miller Hydraulic Piston Seals: Leather Cup Seals are *standard*, Piston Ring Seals are optional at *no extra cost*, and "Teflon" Cup Seals are available *at extra cost*.

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min. (higher upon request) and the height can be adjusted so that pipe is fed at levels from 30 to 48 in. from the floor. A cut-off saw will be supplied if desired. The take-off equipment will accept vinyl pipe with diameters ranging from 1.7 to 7 inches. *S. A. S. Lavorazione Materie Plastiche, Via Nicomede Bianchi 72, Torino, Italy.*

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Vin-Rock Type R-2 mold release is said to greatly reduce the frequency of release applications needed in plastics molding. When applied in liquid form it dries rapidly to produce a hard, smooth, glossy surface on the mold. It is recommended for compression molding, laminating, casting, and lay-up molding of phenolic, polyester, epoxy, and methacrylate resins. It can be brushed, sprayed, or wiped on molds. Crystal clear R-2 will not discolor plastics nor will it affect their paintability. *Vin-Rock Inc., 8211 Almira Ave., Cleveland 2, Ohio.*

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Danish-made high-frequency preheater delivers 1-kw. heating effect

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Model A25
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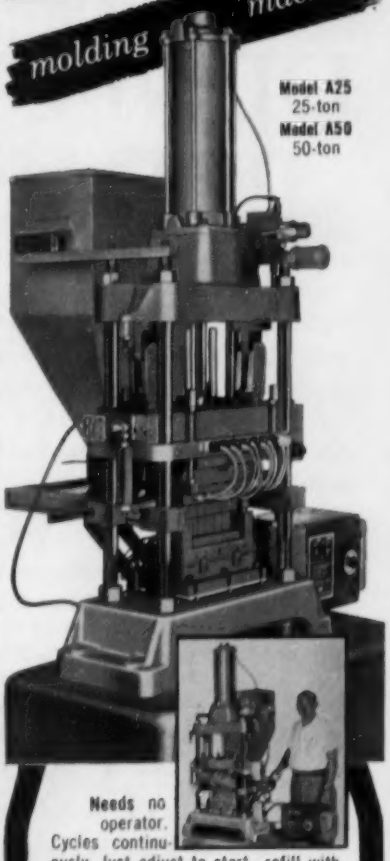

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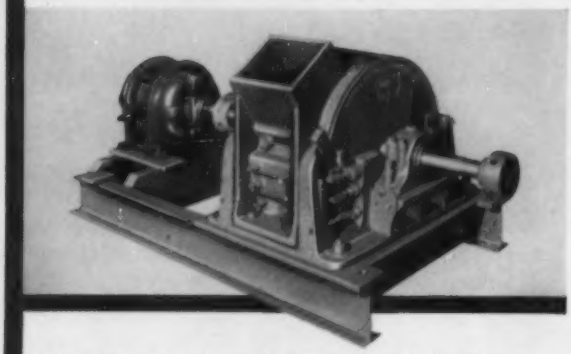

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approximately a little more than 2 pounds.

A second model provides twice the heating capacity of the "Seacastle" Type R4 preheater but is otherwise similar. *Gary Wells Co., 149 Broadway, New York 6, N. Y.*

Hopper-dryer

A new hopper-dryer designed to be attached directly to injection molding machines has a nominal capacity of 200 lb./hr. of feed stock, a figure which varies somewhat with the material being fed. The dryer works by a combination of heating and de-humidification of the intake air so that the air inside the drying chamber is maintained at a very low relative humidity. It is simple to install, sets on the floor next to the molding machine, and is especially recommended for use with the Whitlock hopper loader. The only attention required is periodic changing of the air filter. *C. H. Whitlock Associates, 21655 Coolidge Highway, Oak Park 27, Mich.*

Panel saw

A two-way panel saw is claimed to save time and manpower and at the same time to produce a cleaner and more accurate cut. Being turntable-mounted, the saw can be used for either ripping or crosscutting. The saw runs on steel tracks. Over-all dimensions are 12 ft. long by 6.6 ft. high by 2 ft. wide. *R. C. Bennett Mfg. Co., Laceyville, Pa.*

Trim kit for fabricators

Model 5023 trimming kit is specifically designed for use with the Porter-Cable Models 511 and 100 routers. The kit permits simple and accurate trimming of laminated plastics and other materials. The bit guide of the trimmer has been designed to do away with edge burring, jamming of bearings, and loss of adjustment. A single bit handles both level and flush trimming. Micrometer-type threads on the centering screw give fine adjustment. The smooth action of a nylon roller permits accurate trimming of edges even around corners. *Porter-Cable Machine Co., 70 Exchange St., Syracuse 8, N. Y.*

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Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"ASTM Standards 1955" Part 6

Published in 1956 by the American Society for Testing Materials, 1916 Race St., Phila. 3, Pa. 1776 pages. Price: $13.00

Part 6 of a seven-volume work which includes more than 2150 standard specifications, tests, and definitions for materials, covers 300 standards and tentative specifications. The subjects include plastics, electrical insulating materials, rubber and electronic materials.

"High Polymers: Vol. X, Polymer Processes"

Edited by C. E. Schildknecht

Published in 1956 by Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y. 914 pages. Price: $19.50.

"The chemical aspects of polymer technology, especially the newer processes employed for preparation, formulation, and shaping of plastics, rubbers, fibers, and adhesives, have remained comparatively unavailable in books. This book . . . is devoted to basic processes used in the polymer field, particularly with a view to bridging the gap between theory and practice." So writes the editor in his preface, and with the exception of shaping processes, the book does a remarkably good job of covering the ground named. Its first six chapters are devoted to polymerization processes, the next five to the technology of particular classes of resins. The remaining seven chapters discuss the new adhesives, stabilization, paste and latex techniques, compounding and processing, reinforcement, and spinning and drawing of fibers. The book is full of useful information on making and compounding polymers and elastomers, and this leaves little space for the processes used in making products from polymers. For example, chapter 16, "Compounding and Processing . . ." presents a thorough survey of compounding but only mentions extrusion, injection molding, etc. The book contains about 2500 references to literature and patents, and has a 42-page index. —*J.F.C.*

"Kunststofftechnisches Wœrterbuch," Vol. I, English-German

By A. M. Wittfoht

Published in 1956 by Carl Hanser Verlag, Leonhard-Eckster. 7, Munich 27, Germany. 389 pages. Price: 42. DM (ca. $10.08); with order for Vol. II, German-English, 38. DM (ca. $9.12).

Progress of the plastic industry in many countries makes international exchange of experience and information essential. The "Kunststofftechnisches Wörterbuch," first published in 1948 and now completely revised, facilitates such exchange. It deals with terms covering production, processing, and utilization of plastics; materials testing; and mold making. In future volumes French and Spanish will be covered.

"Legal Problems in Engineering"

By Melvin Nord

Published in 1956 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. 391 pages. Price: $7.50.

Designed for use and reference by engineers, this book deals with many legal subjects that have a bearing on engineering. While it is not intended to make the engineer independent of lawyers, it does offer helpful information on how to avoid legal problems before they arise and how to work more effectively with lawyers.

Some of the subjects covered are: contracts, sales, negotiable instruments, insurance, workman's compensation, municipal corporations, ethical responsibility of engineers, governmental regulation of business, patents, copyrights, and trademarks, and air and stream pollution.

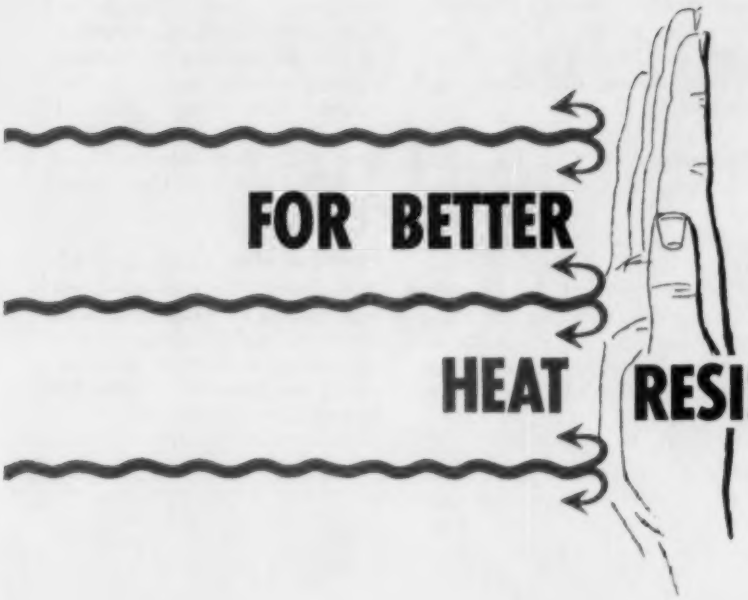
Government specifications. Folder lists official U. S. Government specifications for a wide variety of adhesives, coatings, and sealers. In addition, a cross-reference section lists recent changes in specification designations to aid in correlating old and new specification numbers. *Adhesives and Coatings Div., Minnesota Mining and Mfg. Co., 411 Piquette Ave., Detroit 2, Mich.*

Anhydrides. Booklet F-5280 lists suggested uses, physical properties, specifications, test methods, shipping data, and constant boiling mixtures for acetic, propionic, and butyric anhydride used in the manufacture of textile fibers, plastics, pharmaceuticals, etc. *Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Technical review. Volume 1, No. 1 of a periodical to be published twice a year is a compilation of papers written by Monsanto scientists and engineers. Included in the first issue are: Considerations in the Design of Plastics Structures for Light Weight; Preparation of Actinium Metal; Thermodynamic Properties of the Titanium Chlorides; Multiple Dispersion Regions in Rigid Polymeric Systems; and others. *Monsanto Chemical Co., 1700 S. 2nd St., St. Louis 4, Mo.*

Reinforced plastics. Price lists, physical properties, molding conditions and techniques, and applications of fibrous glass-reinforced polyester (alkyd) molding compounds are presented in file folder form. *Thermaflow Chemical Corp., Tunkhannock, Pa.*

Fibrous glass. Pamphlet gives characteristics, properties, and production information, and describes various types and uses of fibrous glass. In addition, a bibliography lists all the articles dealing with fibrous glass-reinforced plastics that appeared



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in MODERN PLASTICS Magazine and *British Plastics* Magazine from 1941 to the present. *Glass Yarns and Deeside Fabrics, Ltd., Craven House, 121, Kingsway, London, W. C. 2.*

Ethanolamines. A 54-page technical data book describes monoethanolamine, diethanolamine, and triethanolamine, widely used in plastics, paints, glues, etc. Applications, properties, shipping specifications, handling and storing details, etc., are given. *Nitrogen Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.*

Vacuum forming. Information Bulletin 1011 describes production techniques for vacuum forming thermoplastic sheets. Equipment, design factors, finishing and trimming, common problems and their remedies, and a list of suppliers are included. *Monsanto Chemical Co., Plastics Div., Springfield 2, Mass.*

Nylon. Bulletin describes a molybdenum-filled nylon molding powder. Advantages of the compound, as well as properties and test data are presented. *National Polymer Products, Inc., 125 N. Fourth St., Reading, Pa.*

Catalog, price list. A 52-page catalog gives specifications, prices, and properties of thermoplastic and phenolic sheet, rods, tubes, film, and resins, cements, and supplies. *Cadillac Plastic and Chemical Co., 15111 2nd Ave., Detroit 3, Mich.*

Speed reducers. Bulletin 450 describes a line of speed reducers and includes horsepower rating tables, specifications, dimensions, etc. *Farrel-Birmingham Co., Inc., Ansonia, Conn.*

Synthetic rubber. Booklet describes a new synthetic rubber, and gives characteristics, properties, and advantages. *Elastomers Div., E. I. du Pont de Nemours & Co., Wilmington, Del.*

Radioisotopes. Nearly 100 radioactive preparations are listed together with their respective specifications and prices in a revised radioisotope catalog. Descriptions of irradiation facilities, procedure for the procurement of isotopes, shipping information, etc. are included. *Oak Ridge National Laboratory, Union Carbide Nuclear Co., Radioistotope Sales Dept., P. O. Box P, Oak Ridge, Tenn.*

Insulated wire. A six-page pamphlet covers the operation and maintenance of equipment used for non-contact measurement and automatic control of insulated wire diameter. *Industrial Gauges Corp., Englewood, N. J.*

Polyethylene wire covering. Properties, advantages, and descriptions of polyethylene wire coating are given in booklet 88. *Bakelite Co., Div. of Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Plastic packaging. Bulletin C-6-211 is a revised "Directory of Plastic Packaging Suppliers" listing (alphabetically according to city and state) suppliers of packaging made from polystyrene foam, polyethylene, and polystyrene. *Koppers Co., Inc., Chemical Div., Pittsburgh 19, Pa.*

Epoxy resins. Chart lists physical properties of tooling resins, and casting and laminating materials. *Furane Plastics Inc., 4516 Brazil St., Los Angeles 39, Calif.*

Navy prime contractors. This booklet, published as part of a program to acquaint potential subcontractors with the Navy prime contractor contacts, lists nearly 500 firms located in 41 states. *Small Business Branch, Office of Naval Material, Navy Dept., Washington 25, D. C.*

Reinforced plastics. Brochure describes fibrous glass-reinforced plastics for use in jet aircraft ducting. Advantages, properties, etc. are given. *Narmco Mfg. Co., 5159 Baltimore Drive, La Mesa, Calif.*

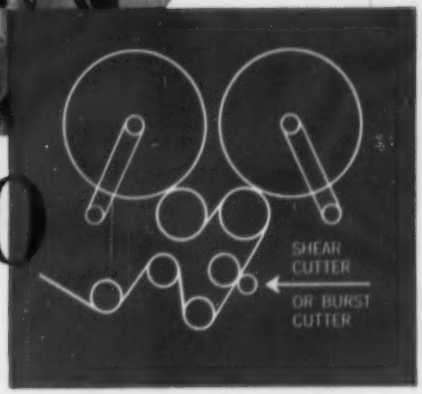
Plastic foam. Booklet describes a lightweight cushioning material for use in furniture upholstery,

(*To page* 302)

Can you meet the big demand for new FOIL wraps?

YES ... with the new 500

The new Camachine 500 is ideally suited for slitting and winding hard and soft aluminum foil, or foils laminated to paper or plastics. The sensitivity and accuracy of both the unwind and rewind controls make it possible to produce top quality, narrow width rolls up to 20" in diameter at speeds up to 2000 feet per minute.*



The 500 is available in other models equipped, as shown in the above threading diagram, with individual rewind drums and individual rewind drives. This arrangement permits flexibility when separating two ply foil at high speeds and gives complete assurance of perfect rolls. 36" diameter rewind capacity is available in heavier models for both the separating operation and for single ply webs.

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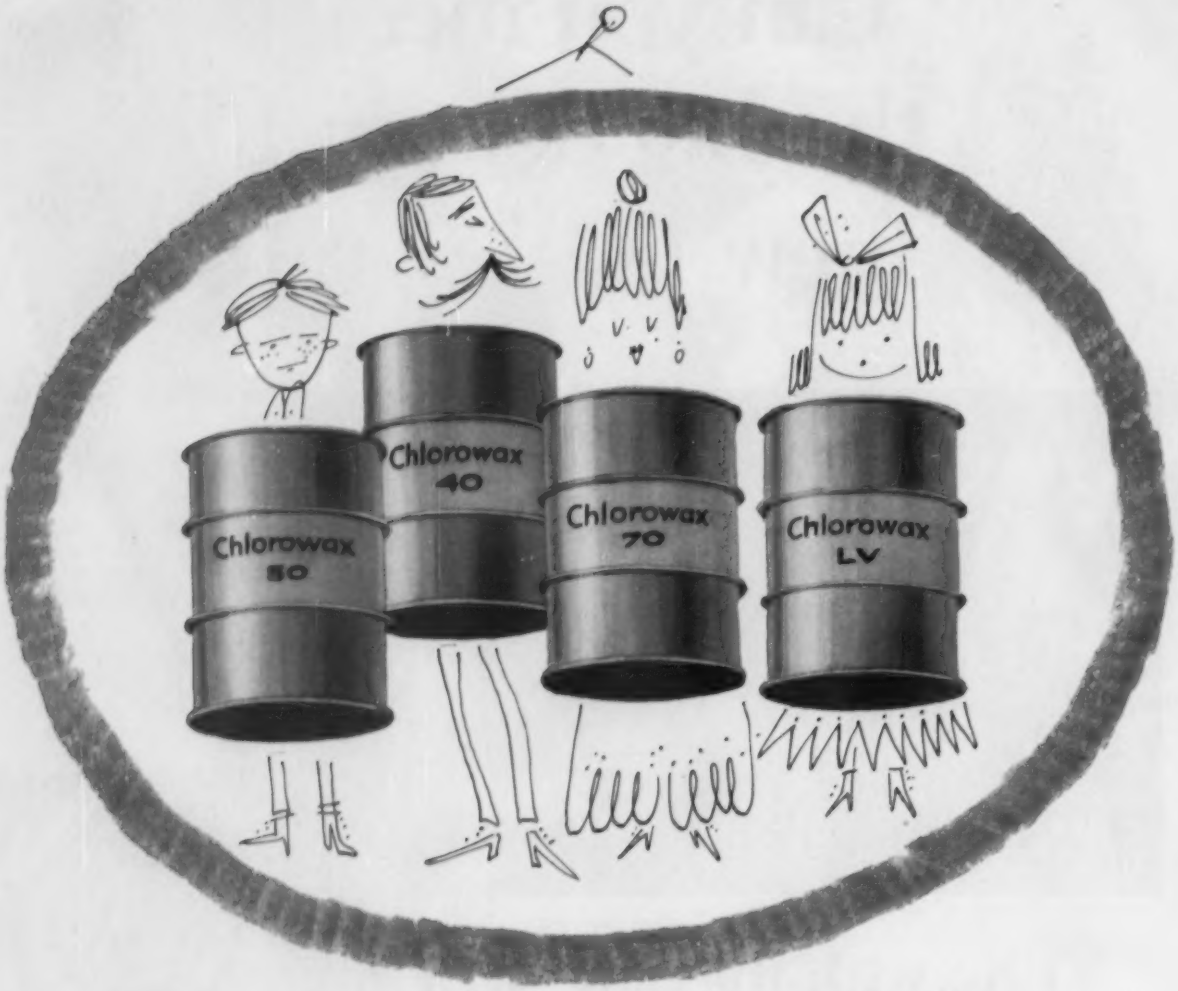

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	Chlorowax 70	Chlorowax 50	Chlorowax 40	Chlorowax LV
Chlorine Content (%)	70	50	40	40
Viscosity (Gardner-Holt poises)	solid	125.0	25	5.0
Specific Gravity	1.65	1.26	1.15	1.13
Weight (lbs. per gal.)	13.7	10.5	9.6	9.4

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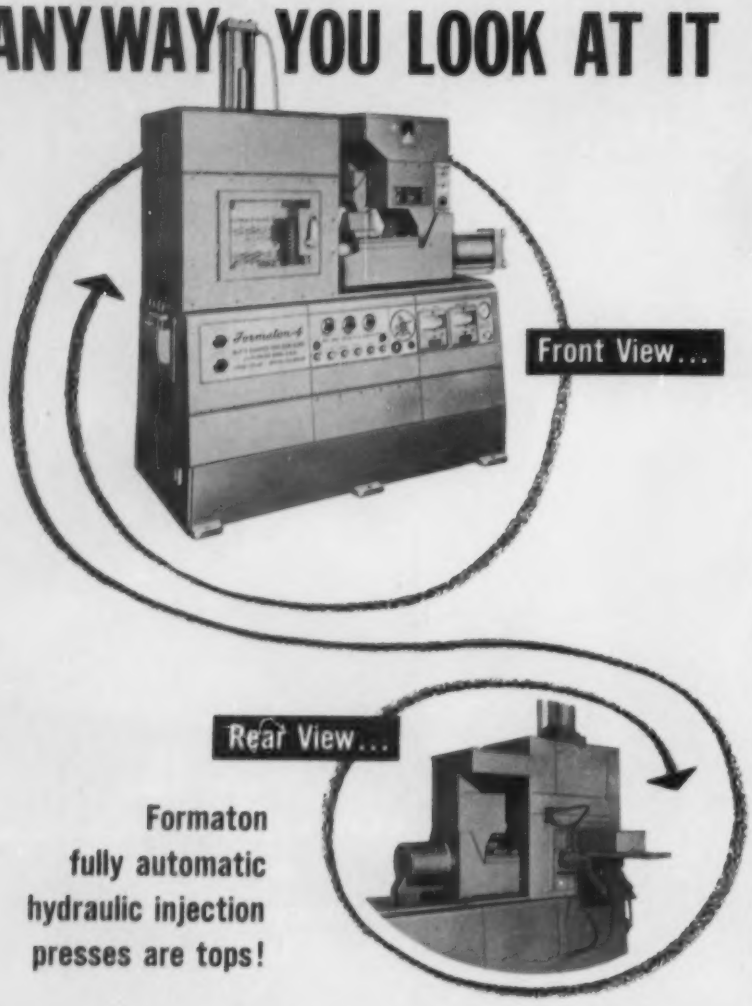

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Ounces per cycle (Styrene pellets)	4
Plasticizing capacity (lbs. per hour)	60
Performance (cycles per hour —max.)	800
Pressure on material (lbs. per sq. in.)	20,000
Standard stroke	7 inches
Locking tons	120
Mold size (between rods)	14 by 18 in.
Mold temp. control range (degrees F)	60—250
High pressure line (lbs. per sq. in.)	1500
Floor space	60 by 80 in.
Height	90 inches

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sporting goods, notions, toys, automobiles, and as an insulating material. Properties and characteristics are given. *Nopco Chemical Co., Harrison, N. J.*

Sandblast machines. Bulletin 1256 describes a line of sandblast machines for cleaning, deburring, surface preparation, stenciling, and matte finishing on metal, glass, and plastics. Dimensions, work range, and operations are given. *Leiman Bros., Inc., 102 Christie St., Newark 5, N. J.*

Coating. Data sheet #85 describes a laboratory-type unit for coating small parts and assemblies with polyvinyl chloride plastisols. Application suggestions are given. *Quelcor, Inc., Front and Broomall Sts., Chester, Pa.*

Reagent bottles. Advantages, specifications, and standard packing weights are given for a line of reagent bottles utilizing a polyethylene dripless sleeve. *E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.*

Electrical tape. Brochure #P6-1 describes a line of electrical tapes made of polyethylene and vinyl. Properties, characteristics, advantages, and sizes are given. *Polyken Sales Div., The Kendall Co., 222 W. Adams St., Chicago, Ill.*

Hobby kits. Volume 10, No. 1 of "Plastics Merchandizer" describes and illustrates various types of kits composed of styrene parts used to construct model boats, planes, autos, houses, railroads, jewelry, guns, etc. *Monsanto Chemical Co., Plastics Div., Springfield, Ill.*

Petrochemicals. Booklet describes a recently completed petrochemical plant. Its facilities, products, sales and distribution are outlined and a fold-out insert giving a pictorial tour of the plant is included. *Escambia Bay Chemical Corp., P. O. Box 467, Pensacola, Fla.*

Laboratory products. A 16-page booklet describes such laboratory items as freeze drying apparatus, polyethylene carboys, clamps,

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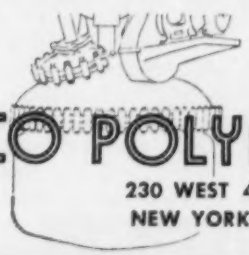

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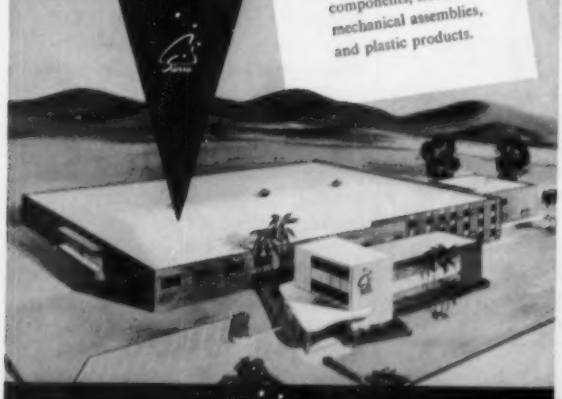

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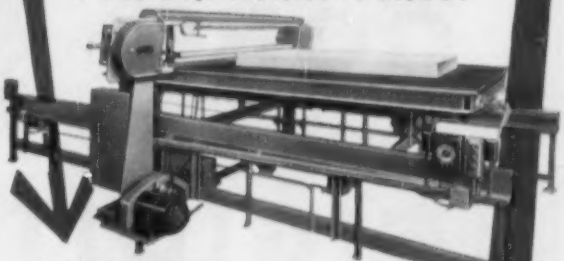
Here's Our New Machine that Levels and Cuts POLYURETHANE SLABS!



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Yes, with FEMCO'S new Polyurethane Leveling and Splitting machine you can easily reduce bulky polyurethane into thin sheets. Save by buying slab polyurethane and fabricating it yourself. And this one-man operated machine is a real labor saver, too!

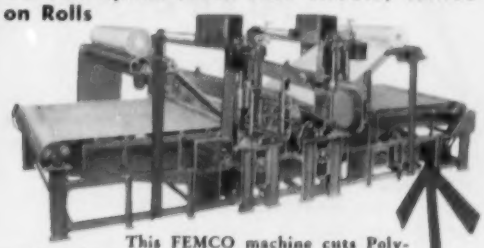
"PUSH BUTTON" OPERATION

After machine levels the slab, operator, from "unload" position, pushes a button. The table glides back and forth and the cutting blade does the rest. The table automatically raises and lowers to clear the cutting blade on the backward movement, then indexes to required thickness before the forward movement.

Available in these table sizes: 45″ x 64″; 45″ x 84″; 64″ x 84″; 64″ x 96″; 84″ x 110″.

Wire, write, or call for details.

DOUBLE-HEAD POLYURETHANE SLAB-CUTTER Splits Stock Into Sheets, Winds on Rolls



This FEMCO machine cuts Polyurethane slabs into sheets (1/16″ if desired) and then winds the sheets into rolls, easy to ship or fabricate. Handles slabs 84″ wide and 25 feet long *(to 100 feet long when power conveyors are added.)*

With the "two-way" or double-head action of the cutter, stock is cut on both forward and backward movements of the conveyor belt; cutter automatically indexes to meet the stock, which is rolled up at each end of the machine. A slab of polyurethane may be split and rolled in minutes. Wire, write, or call us for details and photos.

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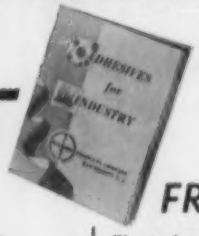

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stirrers, ovens, flash evaporators, pipetting machine, vacuum pumps, etc. *Palo Laboratory Supplies Inc., 81 Reade St., New York 17, N. Y.*

Pressure switch. Specifications, operating characteristics, mounting dimensions, and other data for a new double-circuit pressure switch are given in bulletin 432. *Barksdale Valves, Pressure Switch Div., 5125 Alcoa Ave., Los Angeles 58, Calif.*

Window box. Booklet summarizes the reasons why 10 executives in a variety of consumer fields specified window boxes made of acetate. *Celanese Corp. of America, Plastics Div., 290 Ferry St., Newark 5, N. J.*

Statistics supplement. "Statistical Summary No. 1," first supplement to the fourth edition of the "Chemical Statistics Handbook," contains information in tabular form on wages, hours, employment, production, and price trends in the chemical industry through Oct. 1955. $3.00. *Mfg. Chemists' Association, Inc., 1625 Eye St., N. W. Washington 6, D. C.*

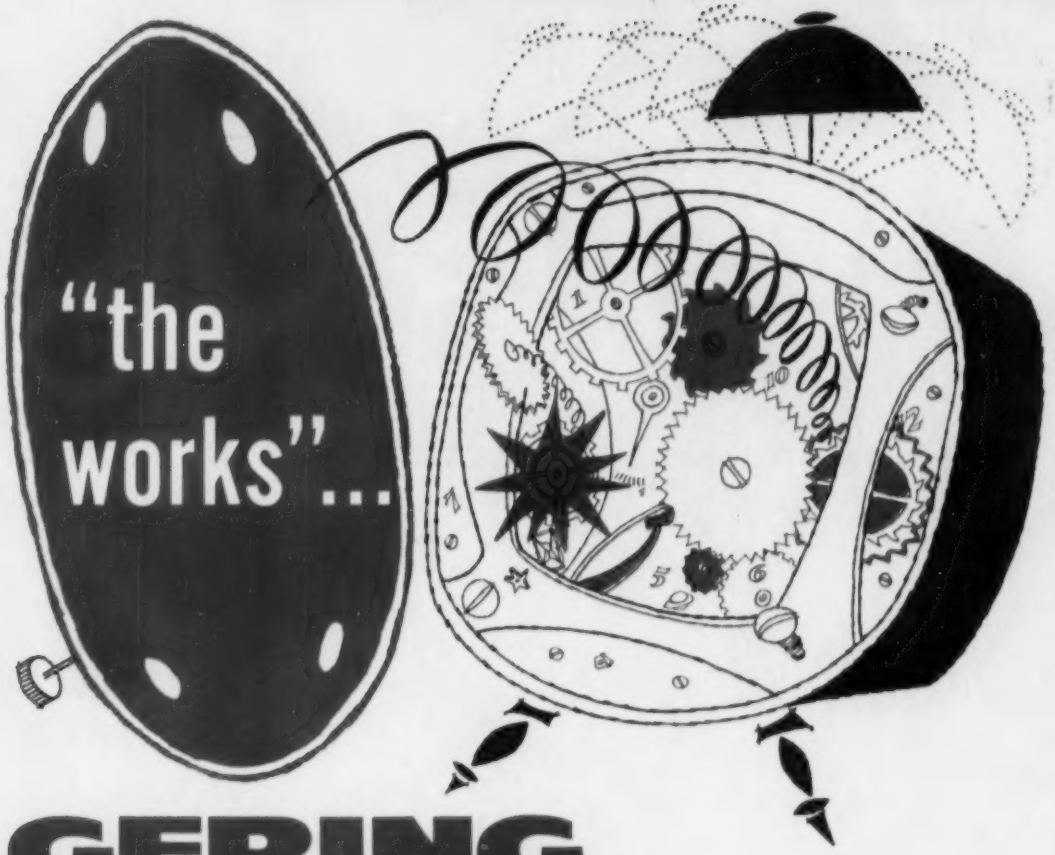
Nylon rod prices. Prices for a line of extruded nylon rod with diameters ranging from 5/16 to 1¼ in. are listed in this pamphlet. *Kemtek Corp., 210 Sylvan Ave., Newark 4, N. J.*

Deflashing. Automatic pellet deflashing of thermoset molded plastics and laminated plastics is discussed in 4-page pamphlet. Four case histories are presented. *Wheelabrator Corp., 315 S. Byrkit St., Mishawaka, Ind.*

Extruders. General characteristics, advantages, accessories, and graphs giving relationship between product weight and output weight for a line of extruders are given in brochure. *Prodex Corp., Box 405, Fords, N. J.*

Case histories. Bulletin 640 describes nine case histories showing how manufacturers in different fields were able to develop new products or manufacturing

(*To page* 308)



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At Gering, scrap reclamation is an important job in which we take great pride. We actually create valuable molding material from space-wasting scrap often considered useless by many manufacturers. Gering provides the modern equipment and the skilled personnel required to set up the highest standards in sorting, separating, grinding, decontaminating, blending, color matching, compounding and pelletizing. This is why Gering assures you the highest quality in uniform reprocessed thermoplastic molding materials.

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WE REJUVENATE by using the most modern equipment and methods known in the entire industry. Gering pioneered in conversion of thermoplastic scrap — and nobody knows how to do this job better than Gering!

WE SELL expertly reconditioned molding powders that do a fine, dependable job to help lower your costs.

Plastic scrap is not waste ... when reclaimed by GERING!

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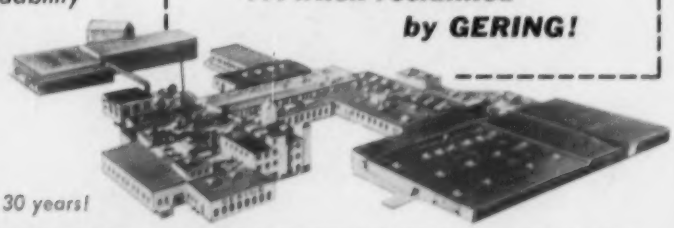
Pioneers in modern plastics for over 30 years!



VISIT OUR BOOTH NUMBER 944-945, NATIONAL PLASTICS EXPOSITION, NEW YORK COLOSSEUM, JUNE 11TH TO 15TH

PLASTIC RAINWEAR is a good example of the way vinyl products can be improved by the right Hercoflex plasticizer specifically chosen to provide the wide range of basic properties needed.

PLASTIC TOYS are another of the end products that give longer service when a Hercoflex plasticizer is used. No matter what the service requirements, there is a member of the Hercoflex family to supply them.

Rain or Shine

HERCOFLEX PLASTICIZERS IMPROVE VINYL PERFORMANCE

No matter what property—or combination of properties—you seek in a plasticizer, there is a Hercoflex that will meet your requirements with "tailor-made" precision.

The Hercoflex family has been developed specifically for those vinyl processors who realize that no single plasticizer can be versatile enough to meet all requirements. That's why so many processors are becoming better acquainted with the Hercoflex family, so that they can select the *one* plasticizer that will do their specific job best.

Whether you want the top performance of Hercoflex 600, the low-temperature flexibility and low volatility of Hercoflex 150, or plasticizers where the major emphasis is on economy, you'll find the answer here.

Would you like to know more? Write to Hercules, outlining your specific requirements, and we'll be glad to send you technical data on the Hercoflex plasticizer that best fits your specifications.

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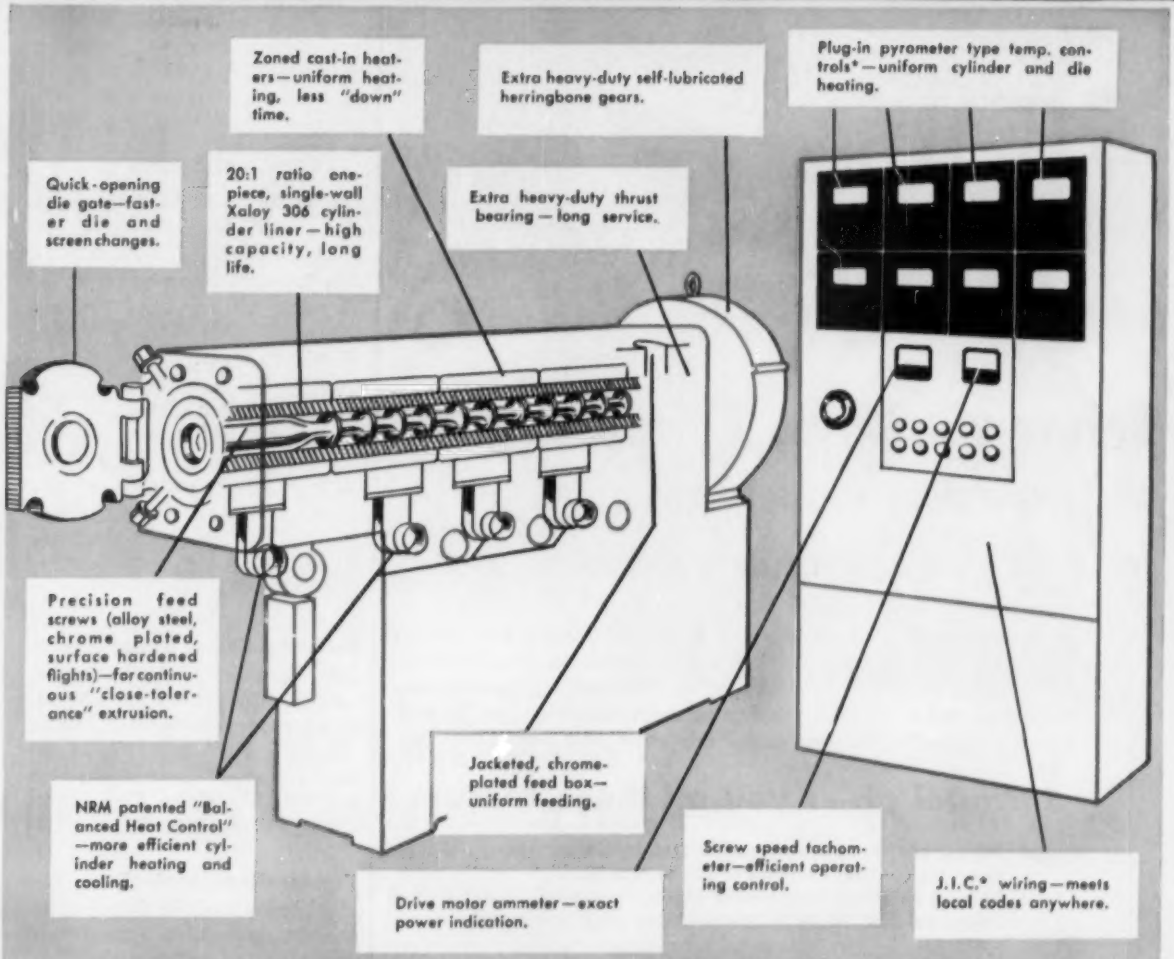
Zoned cast-in heaters—uniform heating, less "down" time.
Extra heavy-duty self-lubricated herringbone gears.
Plug-in pyrometer type temp. controls*—uniform cylinder and die heating.
Quick-opening die gate—faster die and screen changes.
20:1 ratio one-piece, single-wall Xaloy 306 cylinder liner—high capacity, long life.
Extra heavy-duty thrust bearing—long service.
Precision feed screws (alloy steel, chrome plated, surface hardened flights)—for continuous "close-tolerance" extrusion.
Jacketed, chrome-plated feed box—uniform feeding.
NRM patented "Balanced Heat Control"—more efficient cylinder heating and cooling.
Screw speed tachometer—efficient operating control.
J.I.C.* wiring—meets local codes anywhere.
Drive motor ammeter—exact power indication.

Learn how these and many other advanced engineering and construction features assure lower maintenance, **more profit** on plastics extrusion with NRM Extruders. There's an extruder type and size to meet every requirement in the NRM full line. Write today for more details.

*Joint Industrial Council.
*For proportioning type or stepless control.

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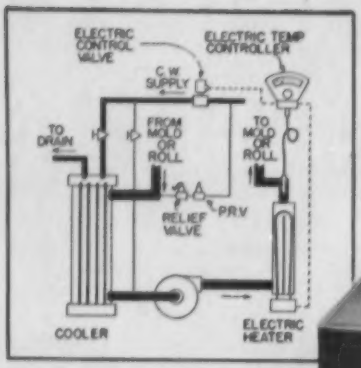
SOUTH: The Robertson Company, Rutland Building, Decatur, Ga.
WEST: S. M. Kipp, Box 441, Pasadena 18, Cal.
MID-WEST: National Rubber Machinery Company, 5875 N. Lincoln Ave., Chicago 45, Ill.
CANADIAN: F. F. Barber Machinery, Ltd., 187 Fleet St., West, Toronto, Ont.
EXPORT: Omni Products Corporation, 460 Fourth Ave., New York, N. Y.

2605

Creative Engineering



Schematic sketch of the control circuit in the Sarcotrol Model MC-1, Single Unit. Model MC-2, Dual Unit, is equipped with two of these circuits, MC-3 has 3 circuits.

Before you buy...Compare
all Temperature Control Units for molds, rolls, cylinders, drums

COMPLETELY redesigned, the new *Sarcotrol* heating and cooling unit is fully automatic as shown in the following list of features. It maintains even face temperatures by recirculating temperature-controlled water at high velocity through molds or roll jackets. Check *Sarcotrol's* features against any other unit *before* you buy.

Sarcotrol gives you *all* these features

- **Dependability** — built and guaranteed by Sarco, makers of temperature controls and steam traps since 1914.
- **No need for special heat transfer liquids** — temperature-controlled water to 300° F. is recirculated at high velocity in closed system.
- **Independent circulating systems** — the Sarcotrol is available with one, two or three independent systems (see above sketch).
- **Simple, sensitive control** — one knob changes temperature control setting; sensitive thermostat (±1°) minimizes temperature lags; easy-to-read dial shows both desired and actual temperatures.
- **Automatic selection of heating rate** — for fast heat-up; then close control.
- **Saves electricity and water** — the *same* thermostat regulates both *rate* of heat input and cooling; cuts out both when set temperature is reached.
- **Automatic heater protection** — heaters are automatically cut off when pump is shut down.
- **Many other features** — are listed in the *Sarcotrol* technical bulletin.

2081 F

See for yourself!
at Plastics Exposition
Booth No. 707

SARCO

Improves product quality and output

processes using this company's research and development facilities. *F. J. Stokes Machine Co., 5500 Tabor Rd., Philadelphia 20, Pa.*

Chemical company. "What it is, what it produces, and where" is the subtitle of a booklet that describes the origins and development, facilities, services, products, etc., of a mining and chemical company. *Montecatini, Via Turati 18, Milano, Italy.*

Textile fiber. Folder lists effects of specified chemicals on fabrics made of Dynel after 20 hr. immersion. Separate sheets give analysis of tests. *Carbide and Carbon Chemicals Co., 30 E. 42nd St., New York 17, N. Y.*

Cement. Technical bulletin describes a line of industrial cement, white glue, wall tile cement, black mastic, etc. Specifications, advantages, and methods of application for each are given. *Midcontinent Adhesive Co., Grove City, Ohio.*

Roller coating. A 6-page booklet describes roller coaters as used in coating applications for wood, metal, paper, plastic, cork, fabric, veneer, and cardboard. Specifications and applications suggestions are included. *Union Tool Corp., 836 N. Detroit St., Warsaw, Ind.*

Temperature controller. Revised bulletin 1025B describes an electric indicating temperature controller. Advantages, specifications, and an operational sketch are given. *Sarco Co., Inc., Empire State Bldg., New York 1, N. Y.*

Cements. Revised 12-page bulletin describes corrosionproof cements, furan-, phenolic-, sulfur-, polyester-, and silica-based materials are discussed. *The Atlas Mineral Products Co., Mertztown, Pa.*

Carbides. Most effective cutting speeds for carbide tools, machine tool horsepower requirements, how to determine shank size of single-point tools, carbide tool geometrics, carbide grade selection, and other technical topics

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● Prominent manufacturers, such as the Montpelier Manufacturing Company, specify Glidpol for their truck bodies because they recognize the quality advantages of these versatile resins and the value of Glidden service.

For example, Montpelier's attractive, lightweight delivery van, has superior thermal insulating qualities, will stay new-looking longer because it won't rust, rot or corrode. Maintenance is simple, too, because the strong Glidpol body resists damage, can be easily repaired without special equipment.

Your plastics application, too, may be improved with Glidpol polyester resins, each custom-formulated for specific product requirements. Write for complete data and information on Technical, Laboratory and other Glidden services.

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A request on your company letterhead will bring you a copy of Technical Bulletin MP-656 which fully describes all of the Glidden GLIDPOL resins for casting, laminating, molding and coating.

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Progress in Plastics

are covered in 66-page catalog GT-310. *Carboloy Dept. of General Electric Co., Box 237 Roosevelt Annex, Detroit 32, Mich.*

Acrylic. Brochure gives properties; information on processing, fabrication, and maintenance; and uses of acrylic in the field of lighting. *E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.*

Engineering education. Brochure presents a program of engineering education in polymeric materials, together with data indicating the needs of the plastics industry and the educational opportunities in this field. *Society of Plastics Engineers, Inc., 314 Putnam Ave., Greenwich, Conn.*

Radiation machines. Booklet entitled "High Voltage Electron Beam-Processing" surveys radiation machines and their application in chemical processing, sterilization, and industrial research. *High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass.*

PVC linings. How to choose the best polyvinyl chloride protection for any given corrosive environment is discussed in this pamphlet. Physical and chemical characteristics, advantages and disadvantages, and applications are described for the three most commonly used types of PVC linings. *Kaykor Industries, Inc., Yardeville, New Jersey.*

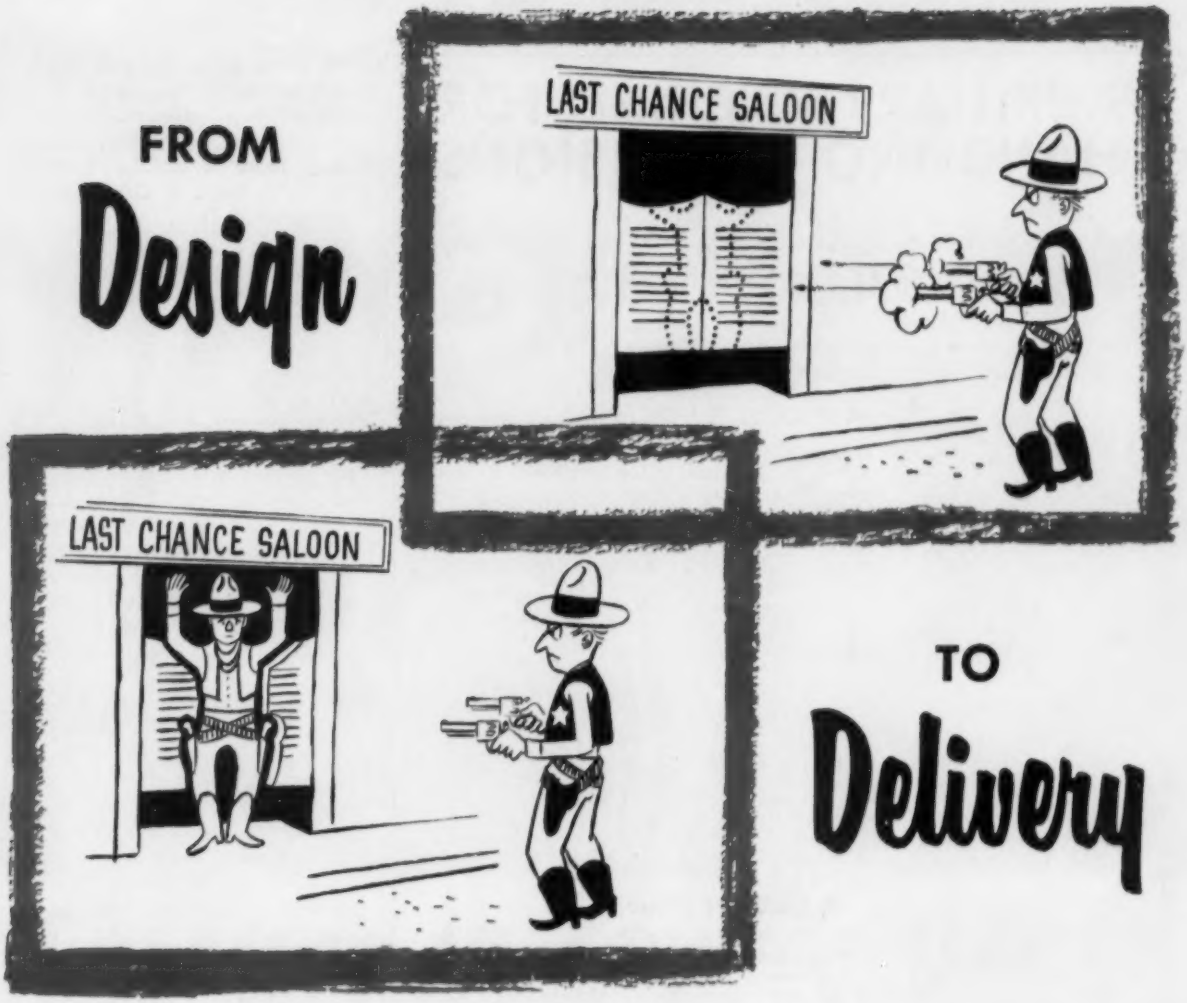
Reinforced plastics. Brochure describes the physical properties, methods of handling, etc., of resins, thickening agents, gel coats, mold release coatings, etc. for the hand lay-up molding of boats, transportation equipment, burial vaults, and others. *Interchemical Corp., 224 McWhorter St., Newark 5, N. J.*

Pumps. Bulletin 1465 describes a line of vacuum and condensate pumps. Specifications, characteristics, and cutaway diagrams are given. *Sarco Co., Inc., Empire State Bldg., New York 1, N. Y.*

Structural adhesives. Report PB 111768 discusses the results of tests performed to determine the

FROM

Design



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then here's a tip. Our complete design, engineering,
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After all, plastics is our business . . . has been for over 40 years.
It's quite possible that what seems like an insurmountable
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injection, transfer molding, and vacuum forming.
So whatever the nature of your job — if it involves plastics —
it will pay you to consult Watertown . . . *first!*

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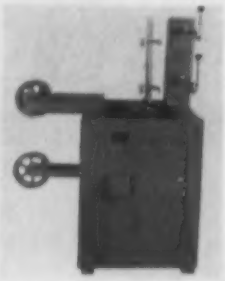
1000 ECHO LAKE ROAD, WATERTOWN, CONNECTICUT

AUXILIARY MACHINES FOR HANDLING EXTRUSIONS

While what occurs inside the extruder has a great effect on the finished extrusion, you cannot overestimate the importance of the handling it receives once it leaves the die. Cooling, tension, take-up and spooling all have a decided effect on the success or failure of your operation. Progressive machines for these operations have been widely acclaimed for their reliability, for their ease of adjustment, and for their ability to reduce scrap losses.

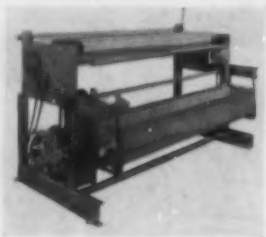


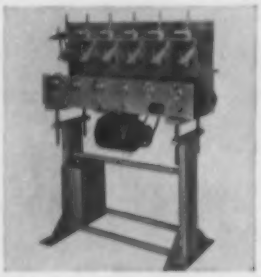
◄ SPOOLING MACHINE

This unit neatly winds extruded strips such as shoe welting, lacing, tubing, and strip gaskets onto spools. The standard model handles a 12" diameter spool, 12" wide. Adjustable traverse for different width extrusions insures even winding. Diameter build-up is compensated for by dancer rolls which maintain constant linear winding speed and uniform tension. The drive has a speed range from 120 to 1.

WATER BATH ►

A cooling unit of this type is absolutely essential in the extrusion of plastic film. The Progressive Water Bath consists of a stainless steel water tank of adjustable height which is mounted in a rigid frame. The pull roll is chrome plated; the nip roll is covered with neoprene. The machine is equipped with adjustable edge slitters and with a polished maple slat expander to eliminate wrinkles from the film.





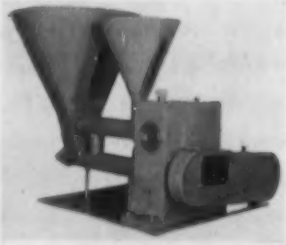
◄ RIGID PIPE PULL-OFF

This machine pulls pipe from the die at a uniform rate. Six paired rubber covered pull rolls and adjustable spring-loaded hold down rolls distribute tension over a length of pipe. The hold down rolls have quick toggle release for starting the pipe. The standard unit accommodates up to 8" O. D.; the roll assembly is adjustable for various other diameters. A 20 to 1 speed range electronic drive powers the machine.

FASTER COLOR MIXING AT THE EXTRUDER

Progressive has developed a new mixing method for extruders who want fast color changeovers with minimum waste material and minimum downtime. This method eliminates the necessity for stopping the extruder for cleaning, or for making any alterations in the extruder set-up.

The Progressive color mixer fits the hopper of any extruder. It feeds and mixes neutral dry-blend powder and carefully measured portions of color chips. The delivery of the unit is matched to the extrusion rate. *Full details on this cost-reducing device are available on request.*



Progressive also manufactures automatic batchers, cut-off reels and slitters, hemming and sealing machines, film tubers, and other machines for plastics extrusion and film handling.

Progressive machine co., inc.

Specialists in Plastic Film Handling Equipment

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most suitable type of commercially compounded metal-to-metal structural adhesive. Silicon resins, rubbers, copolymers, were among those evaluated. $3.00. *OTS, U. S. Dept. of Commerce, Washington 25, D. C.*

Plasticizer. Properties, characteristics, and applications of a low-cost secondary plasticizer are discussed in technical bulletin O-104. *Monsanto Chemical Co., Organic Chemicals Div., 800 N. Twelfth Blvd., St. Louis, Mo.*

PVC pipe. Technical bulletin 80-3 gives engineering data on a line of PVC pipe and lists over 200 chemicals it will convey without being attacked. Characteristics and advantages are given. *Joseph T. Ryerson & Son, Inc., P. O. Box 8000-A, Chicago 80, Ill.*

Laminate. Brochure entitled "A Laminate for Automation" describes a phenolic paper-base laminate for use in the production of printed circuits. Advantages and characteristics are given. *General Electric Co., Laminated and Insulating Products Dept., Coshocton, Ohio.*

Variable-speed drives. Bulletin H-2104 explains services and parts available for a line of electronic variable-speed drives. Listing of parts and prices is included. *Reliance Electric & Engineering Co., 1088 Ivanhoe Rd., Cleveland 10, Ohio.*

Masking tape. Brochure P6-4 describes a crepe paper masking tape. Characteristics, advantages, and properties are given. *The Kendall Co., Polyken Sales Div., 222 W. Adams St., Chicago, Ill.*

Inks. Properties, methods of application, and uses of a line of fluorocarbon pigmented inks are described in a 4-page brochure. The uses of these inks for labelling, coding, or marking surfaces of materials are discussed. *The M. W. Kellogg Co., Chemical Mfg., Div., Jersey City, N. J.*

Technical papers. The 1956 edition of Collected Technical Papers contains the texts of 51 separate lectures and a panel discus-

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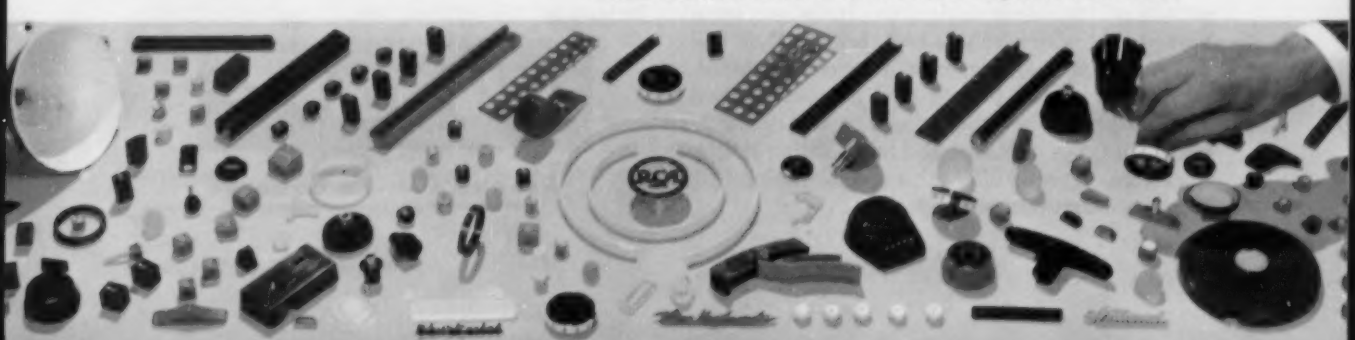

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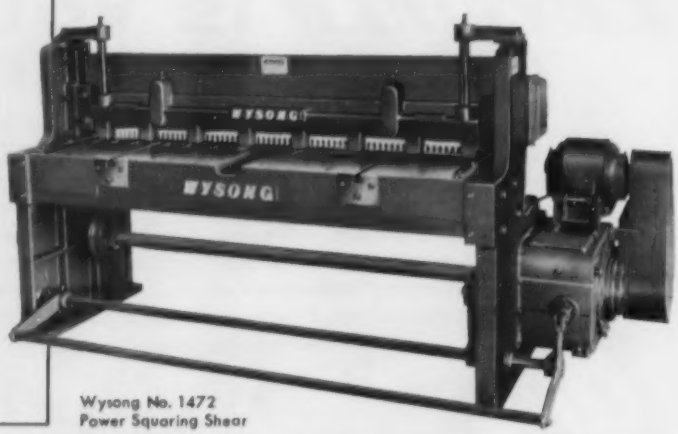

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Send a sample of the material you wish to shear to Wysong. It will be tested for shearing by Wysong Engineers. They will recommend the slope and setting of top blade and other variations on a Wysong shear to give you best results. They will also send you a sample cut of your own material.

Experience has proven that no standardized blade setting or beveling does satisfactory shearing on all types of plastic and composition sheets. Therefore, Wysong offers this special engineering service without cost or obligation.

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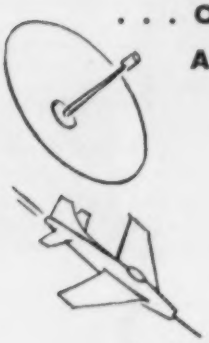

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NEW ENGLAND, Insulating Fabricators of New England, Inc., 69 W. Grove St., Watertown 72, Mass.

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sion presented at the recent 24th Annual Convention of the A.S.T.E. $4.00 to A.S.T.E. members; $7.50 to non-members. *American Society of Tool Engineers, 10700 Puritan Ave., Detroit 38, Mich.*

Dry coloring. A pamphlet on the fundamentals of dry coloring compounds for injection molding and extrusion is offered, together with price lists for standard dry colorants. *Plastics Color Co., 233 Broad St., Summit, N. J.*

Cements. Information on physical properties, compounding, and formulation is given in Bulletin No. 9 for a line of rubber-based cements for use in bonding plastics, paper, wood, ceramics, etc. *Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn.*

Preprinted tapes. Bulletin describes adhesive-backed, pressure-sensitive tapes and sheets which are preprinted with lines, bars, shapes, and symbols used in preparing graphs, charts, and layouts. *Chart-Pak, Inc., 100 Lincoln Ave., Stamford, Conn.*

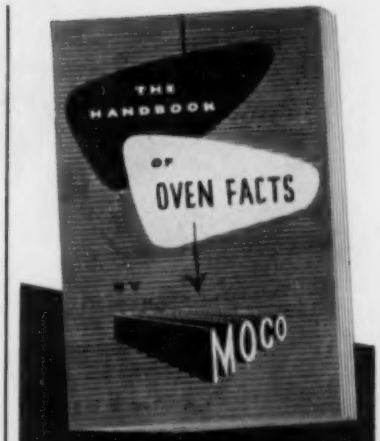
Extrusion. "Extruderitems" No. 4 is a reprint of an article entitled "High-Gloss, High-Impact Styrene for Vacuum Forming" given at the 12th Annual Conference of The Society of the Plastics Industry. *Bakelite Co., a Div. of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Air shipping. Booklet explains air shipment terms, and gives information regarding international shipment, responsibility for damages, carrier restrictions, and load limitations. Case histories are included. *Hinde & Dauch, Sandusky, Ohio.*

Package for liquids. Brochure describes a corrugated box with a polyethylene liner for the storage and shipment of bulk fluids. *Chase Bag Co., 309 W. Jackson Blvd., Chicago 6, Ill.*

Fibrous glass panels. Brochure RC 356 describes the uses of translucent fibrous glass-rein-

(*To page* 319)



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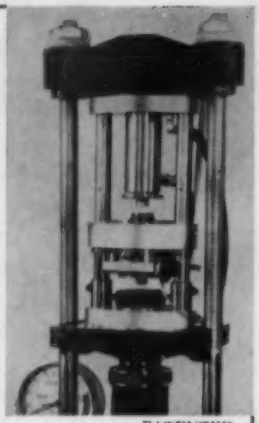

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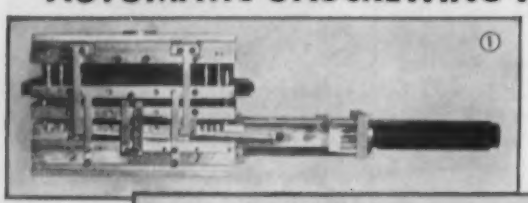
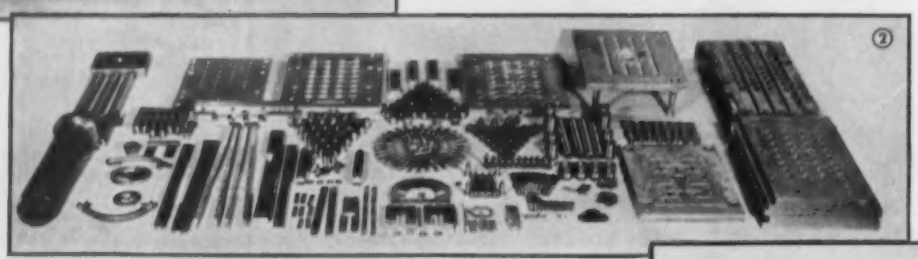
AUTOMATIC UNSCREWING AND DEGATING INJECTION MOLDS

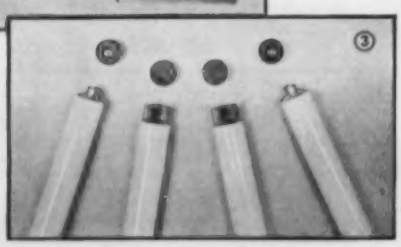


Eagle Tool and Machine Company is completely equipped with machining and handling facilities for the best in mold design and construction, from the smallest, most complicated molds to the largest. We have recently completed a mold weighing over twelve tons. Your inquiries will be given prompt attention.



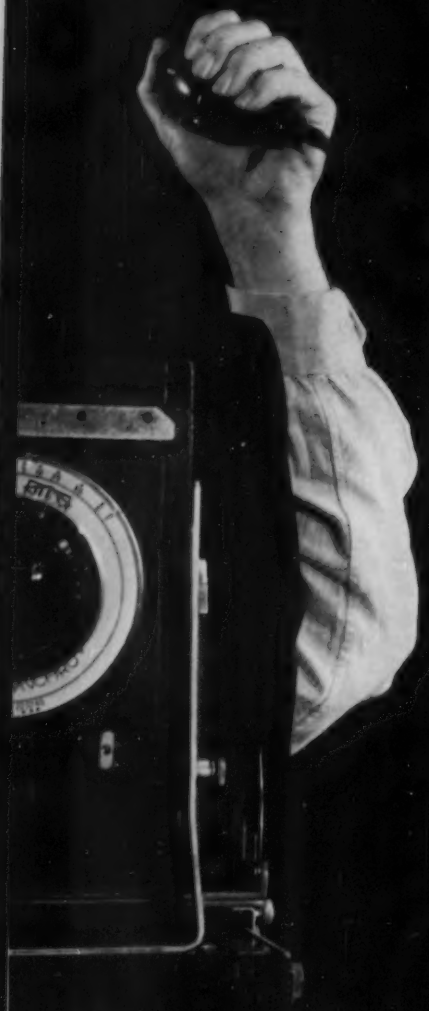
1. MOLD ASSEMBLED. 2. MOLD DISASSEMBLED. 3. TUBE CAPS

The automatic mold, shown in photographs Nos. 1 and 2, has been disassembled for the purposes of this advertisement, after being run in continuous operation for over 15,000,000 pieces. It has over 600 parts. This mold was produced for Sunex Division of Sun Tube Corp., Hillside, N. J. for the manufacture of collapsible tube caps as pictured in the third photograph.



EAGLE TOOL AND MACHINE CO.
EVANS TERMINAL ROAD, HILLSIDE, N. J.
SINCE 1918
TELEPHONES: ELIZABETH 4-1515-16

WE SUPPLY COMPLETE FACILITIES IN DESIGN AND CONSTRUCTION OF INJECTION COMPRESSION, TRANSFER, PLUNGER AND LOW PRESSURE MATCHED MOLD APPLICATIONS.



anything that can be photographed... can be duplicated on GEN®

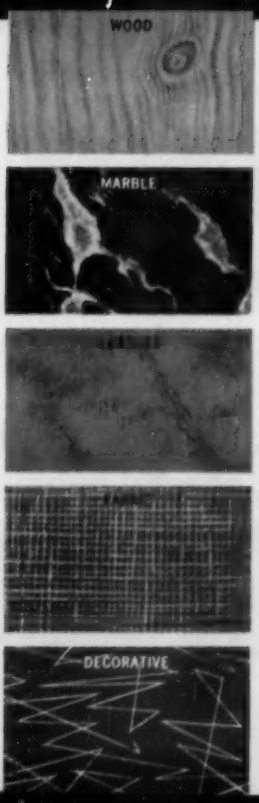
a completely new idea in decorative plastic sheeting

Where can you use GEN 715?

Applications for Gen 715 are literally without limit. Here are just a few suggested uses—appliance interiors and housings • furniture • wall and ceiling tile • advertising specialties • motion picture and stage settings • three-dimensional "wood" paneling • displays and advertising signs

Right now you probably can think of many other ways of using Gen 715. More ideas will come to mind. For the present —if you would like samples of Gen 715 plus additional information, write to

PLASTICS DIVISION
GENERAL AMERICAN TRANSPORTATION CORPORATION
135 South La Salle Street • Chicago 90, Illinois



Available in extruded sheets.. or vacuum formed to your specifications

Gen 715 opens up a whole new world of creative possibilities for designers. By means of an exclusive process, General American Plastics Division is now able to supply plastic sheeting and formed parts that bear perfect reproductions of any material, pattern or design. Gen 715 is available in widths up to 40 inches and any desired lengths . . . in thicknesses from .040 inches to .187 inches.

See GEN displayed at the General American exhibit, 7th National Plastics Exhibition

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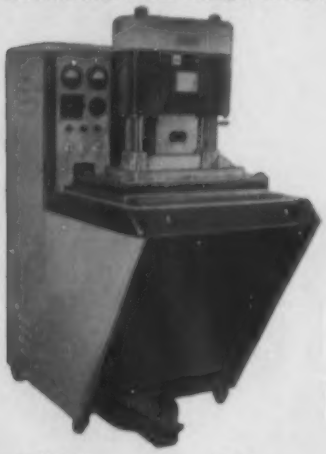
The new FIAB Heat Sealing Machine Type 5001

Output 5 kilowatts

A machine of entirely new design for heat sealing plastic materials, capable of satisfying the most exacting demands. Particularly suitable for sealing book covers, packaging articles and larger-sized inflatable items. Descriptive literature with technical data is readily available, and demonstrations will be arranged on request.



- Press air cylinders run under reduced pressure in all but the lowest portion of travel
- Synchronized time relay
- Sensitive current limiter
- Resettable counter
- Large easy-reading instruments
- Double controls for output regulation
- Table has both T-groove and guide rule
- Two push-buttons for convenient operation
- Double-action pedal
- Seals table 19" x 25".

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Experienced branch agents are wanted as sole representatives in those countries where we are not yet represented.

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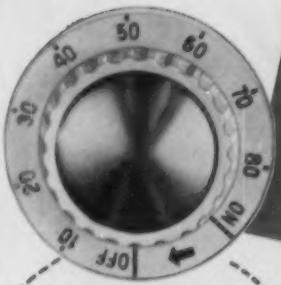

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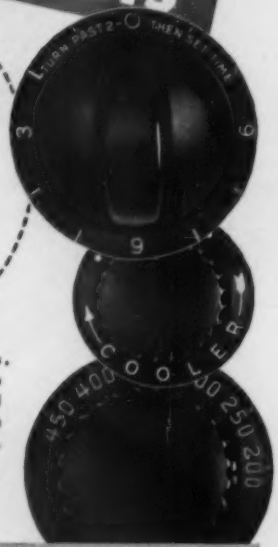

No need to pay excessive tooling costs, when you need knobs. Rogan can supply them from stock molds modified to your specifications, branded with your markings, at substantial savings. Send for details now.

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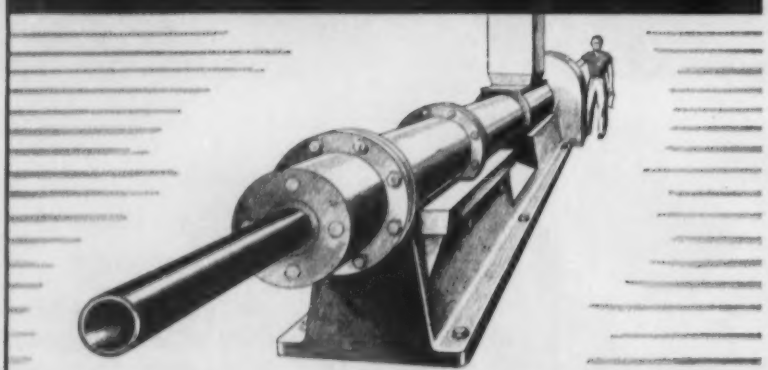
8029 N. Monticello • Skokie, Ill.

COMPRESSION MOLDERS AND BRANDERS OF PLASTICS

"Colloid Corner" by COLUMBIAN



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• They're available in almost every useful medium. One is ideal for your purpose.

• Consult us about your dispersion problem or send now for technical information on Columbian Colloidal Dispersions.

forced plastic panels in home building and remodeling. *Alsynite Co. of America, 4654 DeSoto St., San Diego 9, Calif.*

Speed Nuts. Folder entitled "The Speed Nut Story" lists types, uses, methods of application, specifications, advantages, etc. for a line of fasteners suitable for use in assembling plastics and other components. *Tinnerman Products, Inc., Cleveland 1, Ohio.*

Polyethylene. Booklet lists applications, specifications, and properties for all kinds of polyethylene resins made by the company. *Monsanto Chemical Co., Overseas Div., St. Louis, Mo.*

Plastic laminating. Booklet entitled "The Glasser's Manual" explains how to repair, restyle, and build auto bodies; coat boat hulls; repair and build furniture and art objects; and make household and industrial repairs with various glass-reinforced plastics. $1.00. *Taylor & Art, Inc., 1710 E. 12th St., Oakland 6, Calif.*

Calcium carbonate in PVC. Descriptions and properties of a very finely divided calcium carbonate for use in improving the electrical properties of polyvinyl chloride compounds are given in Technical Bulletins 131 and 140. *Pluess-Staufer (North American) Inc., 82 Beaver St., New York 5, N. Y.*

High-pressure apparatus. Catalog lists and describes various high-pressure apparatus for research laboratories as well as chemical and physical industrial processes. Included are reaction bombs; vertical, horizontal, rotating, and shaking autoclaves; catalytic contact apparatus; etc. *Chemtech Products Corp., 276 Forest Ave., Glen Ridge, N. J.*

Chromatography. Catalog AC-56 lists equipment, accessories, and chemicals currently being used in chromatographic analysis. *Schaar & Co., 754 W. Lexington St., Chicago 7, Ill.*

Test service. File folder includes two brochures which describe weathering, corrosion, and

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- Automobiles
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At Michigan Plastic Products, Inc. modern specialized equipment in the hands of experienced craftsmen assures you of custom quality at competitive prices. All phases of designing, engineering and production are handled under one roof, including molding, assembly, painting and finishing.

Specialists in injection molding of thermo-plastic materials, Michigan Plastic Products, Inc. is equipped with seven Reed-Prentice injection machines ranging in capacity from 4 ounce thru 32 ounce.

If your product requires a practical, low cost plastic part, designed and delivered from one source, write or call Michigan Plastic Products, Inc. today!

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INFRARED HEATING PANELS

New infralite panels for forming thermoplastic sheets featuring complete flexibility are now available. Heating elements easily snap in or out of unit to accomodate sheet sizes 24" x 36" up to 48" x 72" and up to ¼" thick. Ideal for forming thermoplastic sheets. Check these outstanding features!

- LOW OPERATING COST
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Send today for descriptive literature.

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ROEHLEN ENGRAVING WORKS, INC.

MANUFACTURERS OF *Embossing Rollers and Plates*

324 ST. PAUL ST., ROCHESTER 5, NEW YORK

sunlight and storage exposure tests on plastics, adhesives, building materials, etc. *South Florida Test Service, 4201 Northwest 7th St., Miami 34, Fla.*

Standard supplies. Catalog lists specifications, sizes, and prices for a line of standard mold parts, tools, and supply items, and mold polishing supplies for the plastics industries. *Detroit Mold Engineering Co., 1217 Central Ave., Hillside, N. J.*

Vinyl foam. A 24-page booklet describes many of the uses to which vinyl foam can be put. Advantages are detailed and a sample piece of foam is included. *Rubatex Div., Great American Industries, Inc., Bedford, Va.*

Release agents. Described in eight-page booklet are three different silicone products designed to be used as release agents in shell-molding. *Silicones Div., Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y.*

Dispersions. Revised four-page booklet "A list of 'dag' Dispersions for Industry" presents the properties of 41 colloidal and semicolloidal dispersions, including operational and mold-release lubricants for the plastics, glass, ceramics, and rubber industries. *Acheson Colloids Co., Div. of Acheson Industries, Inc., Port Huron, Mich.*

Chemical catalog. Over 7300 commercially available chemicals are listed in 370-page Catalog 120-C. Also given are structural formulas, formula weights, melting and boiling points, and color-index numbers. Available free to laboratories. *Fisher Scientific Co., 374 Forbes St., Pittsburgh 19, Pa.*

Coatings, adhesives. Revised catalog gives properties and descriptions of protective coatings and industrial adhesives. *Magic Chemical Co., 121 Crescent St., Brockton, Mass.*

Adhesives. Technical bulletin presents engineering data on adhesives for honeycomb structures. Test procedures and results are

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FOR QUALITY DYES

excellent miscibility for striking effects in clear plastics . . . a popular dye for toys and novelties.

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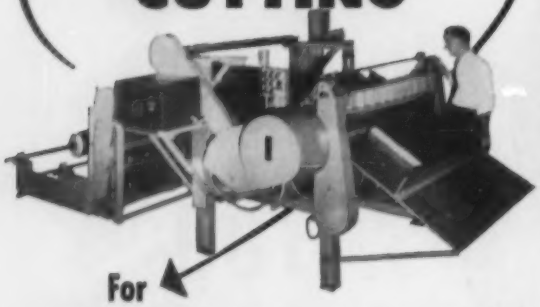
HOBBS

Engineers

AUTOMATIC CUTTING



For

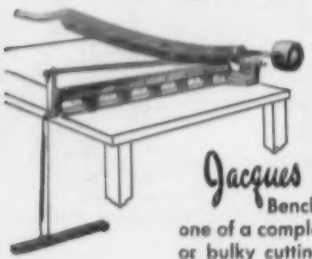
BURKHARDT CO., Detroit, Mich.

The Hobbs Production Cutter shown here was specially designed for Burkhardt Co., manufacturers of loose leaf binders and similar products. This machine automatically slits and cuts leatherette, acetate and coated fabrics received from rolls, and delivers it to a stacker.

Materials up to 60" wide can be slit and cut into various widths and lengths. Production varies according to length of cut. However, in a typical operation 24" lengths are cut at the rate of 3000 pieces per hour.

If width is slit into 3 sections, production of pieces is tripled.

Accuracy is described as exceptional, with savings in materials through elimination of waste.



Jacques

HOBBS ALSO MAKES HAND SHEARS

Bench model shown here is one of a complete line for light gauge or bulky cutting of web widths from 12" to 10' — practically all soft materials.

SEND FOR THE HOBBS ENGINEERED CUTTING BROCHURE — This brochure will help you to determine what type of cutting equipment is best suited to your requirements.

OR TELL US YOUR CUTTING REQUIREMENTS and send us a sample of your material. We'll make recommendations free of all obligations.

HOBBS MANUFACTURING CO.

EST. 1885

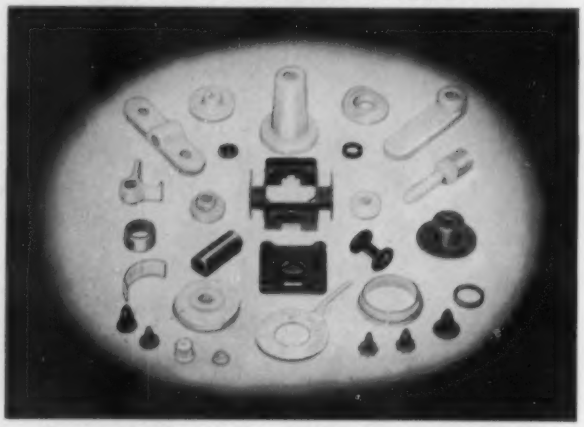
25 Salisbury St., Worcester 5, Mass.

N. Y. Area Office, 821 Eighteenth Ave., Irvington 11, N. J.; Chicago Office, 549 W. Washington Blvd.; South Carolina Office, Parrott & Ballentine, 310 South Carolina Bank Bldg., Greenville; Canadian Representative, The E. V. Larson Company, 572 Queen Street, East, Toronto 2, Ont.; Cleveland Office, P. O. Box 5013, Cleveland 1, Ohio

Winders • Hand & Power Shears • Slitters • Die Presses • Corner Cutters

Custom Injection Molding

PARTS OR FINISHED PRODUCTS



Specialists in Thermoplastics

Nylon — Polyethylene — Styrene Copolymers

• A complete service in our plant from designing, engineering, mold making to high speed production with close tolerances on the latest injection molding machines from 4 oz. to 16 oz. capacity.

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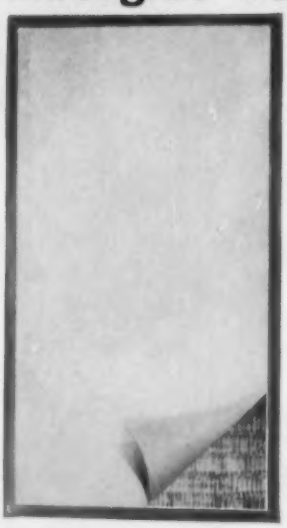
Fiberglas* Radiant Heater



Unit with cover turned back to show radiant heating wires.

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PLASTICS

Textiles • Paper

Engineered to radiate uniform heat to material being processed from edge to edge. Approximately 7.5 watts density per square inch (current consumption at 100% operation). Any voltage—any phase. Precision control maintains desired temperature. Low initial cost.

Also, write for details and prices on our new semi-automatic drape-vacuum forming machine, built to your specifications, yet low enough in cost to use as a sampling machine.

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given for new resin-type and elastomeric adhesives used for bonding aluminum to kraft paper honeycomb core. *Adhesives & Coatings Div., Minnesota Mining & Mfg. Co., 423 Piquette Ave., Detroit 2, Mich.*

Construction materials. Bulletin CC#3 gives basic data on a complete line of corrosionproof construction materials used in metalworking, chemical, petroleum, and other industries. Included are rigid plastics fabrications and pipes, tank linings, protective coatings, etc. *The Atlas Mineral Products Co., Mertztown, Pa.*

Polyethylene, PVC. Revised catalog details a line of polyethylene and PVC sheet, bars, rod, and blocks; moldings and weldments; and welding and spraying equipment. A powder fluidizer designed for coating small objects with polyethylene is also described. *American Agile Corp., P.O. Box 168, Bedford, Ohio.*

Cost comparator. Slide-rule-type cost comparator enables designers and engineers to compare the cost and properties of Mylar polyester film with those of other insulating materials. *Film Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.*

Silicone emulsions. Bulletin lists applications, properties, and characteristics of a line of silicone emulsions used as mold release agents for molding, laminating, etc. *Harwick Standard Chemical Co., 60 S. Seiberling St., Akron 5, Ohio.*

Styrene sheet. Brochure gives properties, characteristics, advantages, and weights for a line of extruded high-impact styrene sheet. A separate brochure gives descriptions of facilities, equipment, and services of this custom molder and extruder. *Auburn Button Works, Inc., Auburn, N.Y.*

Tool steels. Booklet lists over 2800 available stock sizes of air, oil, and water hardening tool steels. Special sections are de-

(*To page* 326)

speaking of VINYL TILE...

Process at lower temperatures with Benzoflex 9·88!

How can we get faster fluxing?

● Leading manufacturers of vinyl floor tile report these big advantages of using Benzoflex Plasticizer: Processing is simplified. Production is faster. Tile finish has a higher gloss . . . all because it can be processed at lower temperatures. Find out what this distinctive advantage of TENNESSEE's Benzoflex plasticizer can mean to *you* for tile, foam, adhesives, paints, plastisols and other vinyl products. Write . . .

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Nylon fabric helps keep America's global jet bombers flying

Press used for nylon laminates for B-52 airplane parts at Swedlow Plastics Company

The Boeing B-52 long range jet bomber is capable of flights of incredible distance. The protection of the fuel cells naturally rates a high priority. To provide this protection, nylon laminated backing board manufactured by Swedlow Plastics Company in accordance with Boeing Specification BMS 8-13 is placed adjacent to the flexible fuel cells to serve as a chafing and support member. Wellington Sears nylon fabric is an intrinsic part of this important Swedlow product. Combined with nylon resins this all nylon laminate provides a light weight, high strength and high degree of energy absorption material necessary for this application. Proud as we are of our part in this important project, it is only one of thousands of fabric constructions — cotton and synthetic — available to industry from Wellington Sears. Whatever your product — if it calls for fabric — call for Wellington Sears. Put over one century of experience in industrial fabric progress to work for you. For further details, write today for illustrated booklet "Modern Textiles For Industry." Address Dept. K6.

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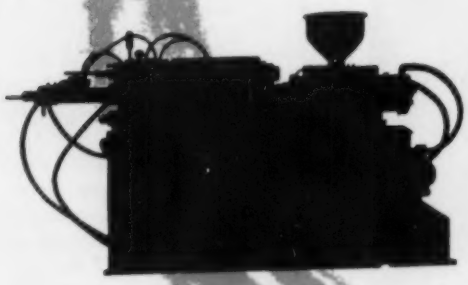
FELLOWS

sets the pace

in speed and automatic operation!



See this pace-setting speed and automatic operation at BOOTHS 405-407-409, PLASTICS EXPOSITION, JUNE 11 TO 15, NEW YORK COLISEUM

Cutting costs per piece in many plants, Fellows Injection Molding Machines are the fastest fully-automatic machines in their capacity ranges.

Dry-run speeds of the new, 3-ounce Fellows 3-125 are from 600 to 840 cycles per hour, from 490 to 650 cycles per hour for the 6-ounce Fellows 6-200. Both are fully automatic, permitting operation of three or more machines per man.

Fellows injection molding equipment

THE FELLOWS GEAR SHAPER COMPANY, Plastics Machine Division, Head Office and Export Dept., Springfield, Vt.
Branch Offices: 319 Fisher Bldg., Detroit 2 • 5835 W. North Avenue, Chicago 39 • 2206 Empire State Bldg., New York 1
6214 West Manchester Avenue, Los Angeles 45

voted to hollow bars, sectional die steels, precision ground stock, and drill rods. *The Uddeholm Co. of America, Inc., 155 E. 44th St., New York, N. Y.*

Acrylonitrile. Technical service bulletin discusses methods for safe storage and handling of acrylonitrile. Construction materials, storage tanks, piping, pumps, valves, filters, etc., are considered. A data sheet giving physical properties of pure acrylonitrile is also included. *Monsanto Chemical Co., Springfield, Mass.*

Skin package adhesive. Folder describes the use of heat-sealing adhesives for the attachment of preformed plastics blister and vacuum contoured films in skin packaging. *Pyroxylin Products, Inc., Chicago 32, Ill.*

Spray painting machine. Brochure describes an automatic reciprocating-type air-operated spray painting machine designed to spray areas up to 12 in. wide and 40 in. long. *Conforming Matrix Corp., 364 Factories Bldg., Toledo, Ohio.*

Chemical bulletins. Bulletin CH-3 lists, with brief descriptions of each, all of the available chemical bulletins that this company has issued on the uses of molybdenum and its compounds. *Climax Molybdenum Co., 500 Fifth Ave., New York 36, N. Y.*

Plastics in building. Brochure describes a course of study devoted to the subject of plastics in building. Outline of program, staff, living accommodations, registration, qualifications, etc., are given. *Massachusetts Institute of Technology, Dept. of Civil and Sanitary Engineering, Cambridge 39, Mass.*

Propylene. Booklet SD-59 gives information on the safe handling and use of propylene, including shipping containers, storage, waste disposal, and health hazards and their control. 30¢. *Manufacturing Chemists' Association, 1625 Eye St., Northwest, Washington 6, D. C.*

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Engineered Heat

has solved many of the toughest jobs in the Plastics Industry!

THERMEL "Custom-Built" jobs are constantly turned into *Standards* that are accepted in the Industry!

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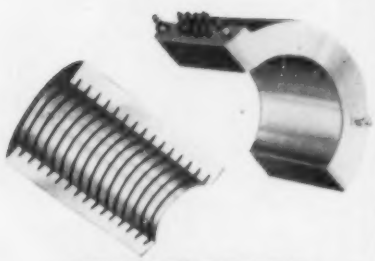
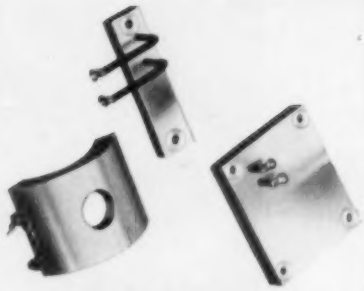
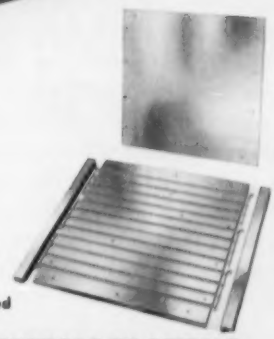
  Thermoplatens (Cast and Steel)
- ***. . . FOR VACUUM DRAWING***
  Radiant Thermatubes — Radiant Cast Platens
- ***. . . FOR PACKAGING — SEALING***
  Cast Heaters — Tubular and Cartridge Elements



THERMABANDS

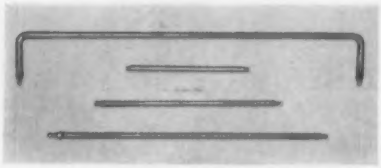


THERMAHEATERS



Exploded View

THERMAPLATENS



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Thermel, inc. 9400 Robinson Road, Franklin Park, Illinois
"A Suburb of Chicago"

DUROID 5600

(REINFORCED TEFLON*)

WASHERS

Beat Torque.... Heat.... Dishwater....

Designers of a new electric frying pan located the control box underneath the handle. This position was ideal for servicing, but it meant that the control box would be completely immersed in dishwater when the pan was cleaned. One of the primary problems was to find a material that would effect a watertight seal under the three screws fastening down the control box cover. Requirements were stiff.

The material would be exposed for long periods to 450°F. It would have to compress but not extrude under the torque pressure of the screws.

Many materials were tried.

Only DUROID 5600 supplied the desired combination of resistance to heat and cold flow.

It's on the pan now — we're even fabricating the pieces.

DUROID 5600
is another example of where Rogers has taken a good material — in this case, TEFLON — and made it better for certain applications.
If you have a product idea or improvement that requires a special material, let us go to work on it.
Combining chemicals and fibres to develop special material properties is our business.
Contact Dept. P.

* Registered trademark of Du Pont Company for its tetrafluoroethylene resin.

Material ideas for product improvement

ROGERS CORPORATION

ROGERS, CONNECTICUT

PRODUCTS

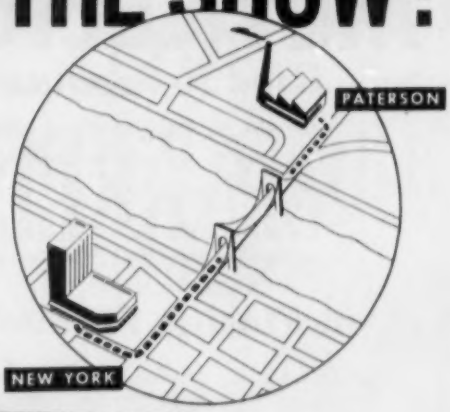
DUROIDS—for Gaskets, Filters, Electronic Devices, etc.
SHOE MATERIALS—for Counters, Midsoles, Liners, etc.
ELECTRICAL INSULATION—for Motors, Transformers, Generators, etc.
PLASTICS—Special Purpose Molding Compounds and Laminates.

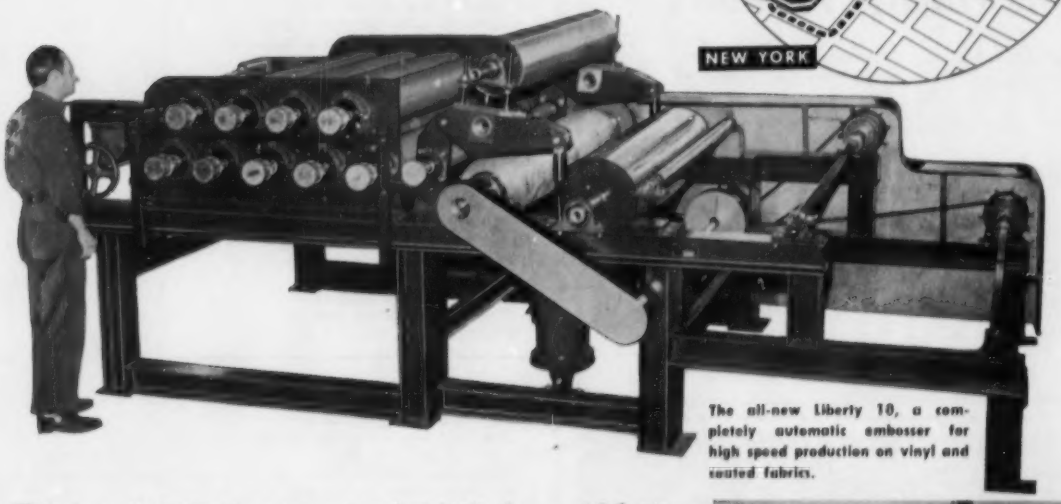
SERVICES

FABRICATING—Including Combining, Coating, and Embossing.
DEVELOPMENT—Research and Engineering of New Materials, Parts, and Products.

IN NEW YORK FOR THE SHOW?

Remember...
you're just 15 miles from
the home of Liberty Machine Co.



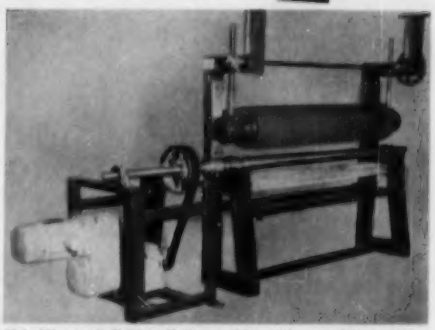


The all-new Liberty 10, a completely automatic embosser for high speed production on vinyl and coated fabrics.

This is an invitation to come out and visit the home of Liberty Machine . . . known in the world of plastics as the home of fine film processing equipment. If you're in the market for embossing machines, one and two color printers, polishing machines, J boxes, or what-have-you, we'd like to have you as our guest in order to get better acquainted with the Liberty line.

We feel this is an excellent opportunity for us to meet our many friends who have inquired of our equipment over the years . . . an opportunity to meet them personally and get to know more about their problems, and perhaps to give them our solutions.

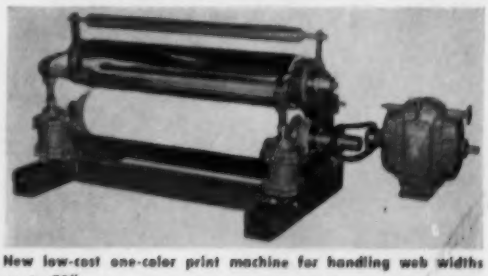
Write today, and we'll arrange to meet you and drive you out. Or when you're in New York, just call Sherwood (Paterson) 2-5565.



This Liberty Polishing Unit provides either a rich matte or high polish finish on vinyl without the need of an extra polishing run.

Why not request a copy of Liberty's 1956 catalog of equipment for plastic film processing. It contains full details and specifications on one and two color printing machines, J Boxes, polishing machines, and embossers.

Even if you can't make the Plastics Exposition, we'd be happy to have you as a guest the next time you're in New York. If you'd like immediate information on all Liberty equipment for the plastics industry, write today for 1956 catalog.



New low-cost one-color print machine for handling web widths up to 72".

LIBERTY MACHINE CO., INC.

275 Fourth Avenue Paterson 4, New Jersey • SHerwood 2-5565

COPPER BASE
METALLICS
Used to Produce
SPARKLE
in Plastics Products
SILVER COLORS
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FULL RANGE AND COLORS
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Sales Agent of the
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BRAND NEW...
DE-STA-CO
MIDGET-U
(MODEL 215-U)
TOGGLE CLAMP!
... with articulated linkage and low closed-silhouette ...
Midget-U is an ideal tiny clamp for light-duty jobs requiring almost effortless positive clamping. It has limitless applications for clamping metal, plastic and wood parts ... Weighs only 4 oz. ... Delivers 150 lbs. holding pressure ... Total length when closed—5⅛"!
OPEN POSITION shows fine articulated linkage of components
CLOSED POSITION shows its low silhouette
Send for Literature on this new DE-STA-CO Midget-U Toggle Clamp!
DE-STA-CO DETROIT STAMPING COMPANY
WORLD'S FIRST LINE OF TOGGLE CLAMPS
327 Midland Avenue • Detroit 3, Michigan

mp Plastics

Production and sales figures in 1000 lb.* for January and February 1956

Materials

Cellulose plastics:[a]
- Cellulose acetate and mixed ester:
  - Sheet, under 0.003 gage
  - Sheets, 0.003 gage and over
  - All other sheets, rods, tubes
  - Molding, extrusion materials
- Nitrocellulose sheets, rods, tubes
- Other cellulose plastics

Phenolic and other tar-acid resins:
- Molding materials[a]
- Bonding and adhesive resins for:
  - Laminating (except plywood)
  - Coated and bonded abrasives
  - Friction materials (brake linings, clutch facings, etc.)
  - Thermal insulation
  - Plywood
  - All other bonding uses
- Protective-coating resins
- Resins for all other uses

Urea and melamine resins:
- Textile-treating resins
- Paper-treating resins
- Bonding and adhesive resins for:
  - Plywood
  - All other bonding and adhesive uses, including laminating
- Protective-coating resins
- Resins for all other uses, including molding

Styrene resins:
- Molding materials[a]
- Protective-coating resins
- Resins for all other uses

Vinyl resins, total[b]
- Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:
  - Film (resin content)
  - Sheeting (resin content)
  - Molding and extrusion (resin content)
  - Textile and paper treating and coating (resin content)[c]
  - Flooring (resin content)
  - Protective coatings (resin content)
  - All other uses (resin content)
- All other vinyl resins for:
  - Adhesives (resin content)
  - All other uses (resin content)

Coumarone-indene and petroleum polymer resin

Polyester resins

Polyethylene resins

Miscellaneous:
- Molding materials[a,d]
- Protective-coating resins[e]
- Resins for all other uses[f]

* Dry basis designated unless otherwise specified.
† Revised. ‡ Partially estimated.
[a] Includes fillers, plasticizers, and extenders. [b] Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c] Includes

Production

From statistics compiled by the U. S. Tariff Commission

January 1956†		*February 1956‡*	
Production	*Sales*	*Production*	*Sales*
1,487	1,462	1,621	1,655
1,314	1,200	1,211	1,143
707	586	613	623
6,492	6,413	7,178	6,959
519	514	497	467
450	328	501	450
19,715	17,635	20,279	16,620
5,981	3,913	5,223	3,914
1,510	1,473	1,409	1,303
1,941	1,592	1,891	1,635
5,173	4,788	4,646	4,783
3,479	2,846	4,040	3,234
2,726	2,720	2,592	2,359
2,743	2,495	2,624	2,255
2,882	2,564	2,719	2,429
4,263	4,206	5,507	5,508
2,209	1,930	2,465	2,006
8,768	7,917	9,326	8,442
3,397	2,397	2,059	1,854
†3,226	†2,461	3,171	2,263
7,774	7,899	7,150	6,560
38,597	33,050	32,289	32,779
†9,849	†7,767	7,650	8,395
8,405	8,257	8,111	8,690
†66,890	†62,456	61,607	58,126
	†6,496		6,849
	4,928		5,296
	16,842		16,509
	6,176		5,187
	5,181		4,894
	2,289		1,792
	6,584		6,185
	3,331		2,718
	10,628		8,696
†21,196	†20,096	18,678	18,939
†5,510	†4,533	5,366	4,066
†42,721	40,068	41,416	38,378
3,921	3,394	3,584	3,326
†595	392	707	415
†10,200	9,150	9,313	8,692

data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

RC Plasticizers
FOR
LOW TEMPERATURE FLEX
IN
SYNTHETIC
AND
NATURAL RUBBERS

If You Want...
- Superior Flex
- Reduced Nerve
- Low Volatile Loss
- Smooth Extrusions

RC PLASTICIZERS
TG-8
TG-9
BD-8

If You Want...
- Processing Aid
- Resilience
- Gasket Materials
- Excellent Retention

RC PLASTICIZERS
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Choose the right plasticizer to do the job best. We'll send you a brochure on other RC products that can speed your operation, improve finished products.

RC

Ready... reliable... RC serving American industry, since 1930

WRITE FOR SAMPLES!
RUBBER CORPORATION OF AMERICA
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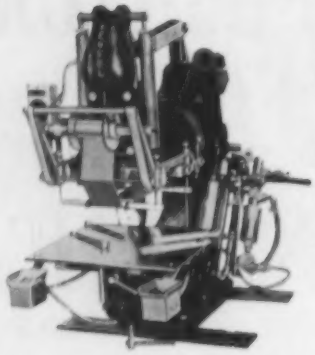
Sales Offices: NEW YORK · AKRON · CHICAGO · BOSTON

Solve your Plastic Marking problems

with

KENSOL Hot Stamping Presses



Kensol 35 T

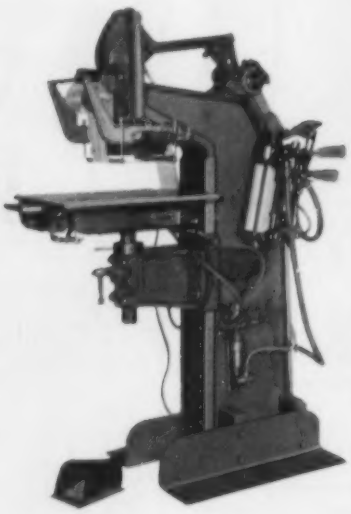
Air-Operated Electrically
Dwell-Timed Power Press

A ruggedly constructed, "C" frame, double toggle press which will produce fine quality hot stamping at a high production rate with an inexperienced operator. Press has 4"x8" stamping area, 3 inch head stroke, and will imprint items from flat up to 2¼" high.

Kensol 100

"Deep Bed" Power Press with
Air-Operated Sliding Tables

Similar to the 35T shown above, except bed can be lowered to accommodate items up to 24 inches high. Both the 35T and 100 will automatically compensate for thickness variations in a run.



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Send for Bulletin B-9 which illustrates and gives complete information on the equipment shown above and four other Kensol models. Bulletin also includes Kensol #20 turntable attachment, large size air-operated roll leaf attachments, and other pertinent information.

and

OLSENMARK Roll Leaf

Send for Color Chart B-11 which shows actual color stampings of the complete line of OlsenMark Roll Leaf. Fine quality, economically priced OlsenMark Roll Leaf is available in pure gold, imitation gold and silver, and all popular colors including luster colors which print with a high gloss.

Going to the Plastic Exposition in New York City?

If so, be sure to visit our plant which is only 20 minutes by subway from the Coliseum. Trained personnel will gladly discuss your marking problems, demonstrate our complete line of equipment (including automatics), and show you finished samples of similar work.

SINCE 1924
OLSENMARK Corporation
124-132 WHITE STREET
NEW YORK 13, N. Y.

Specialists in Quality Marking Equipment and Supplies for over 30 years

Marine bumpers

Lightweight extrusions of polyethylene are now being used to protect small craft from damage and abrasion by acting as cushions between the hull and docks, walls of locks, etc.

Extruded tubing with a wall thickness of approximately 0.190 in. is being made into boat bumpers which float, will not rot or corrode (even after prolonged contact with fresh or salt water), withstand abrasion, are easy to keep clean, and will retain their resiliency at practically all temperatures.

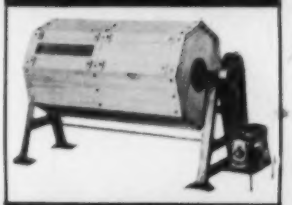
The bumpers are made by cutting the extruded tubing to length and inserting brass grommets into either end. A lanyard to hold the bumper in place on the boat hull is tied to one or the other of the grommets. The bumper is packaged in a polyethylene bag.

Also extruded of white polyethylene in continuous lengths is a "D" shaped section available to dock owners as a protective cushioning for the edges of docks or pilings. A projecting flange extruded as an integral part of the section facilitates attachment of the bumper to the dock with galvanized roofing nails or other corsion-resistant fasteners. The bumper tubing is shipped in 100-ft. coils weighing 47 lb. each, and is also suggested for cushioning garage walls, doors, etc.

Credits: D-Fenders manufactured by Franklin Plastics, Inc., Franklin, Pa.; polyethylene bag for boat bumper supplied by Central States Paper and Bag Co., St. Louis, Mo.

Cushion of extruded polyethylene protects boat hull

SIEBERT
DRY TUMBLING BARRELS
SERVICING THE PLASTIC INDUSTRY
SINCE 1926



* Write for information or send sample of product for test run without obligation

30th ANNIVERSARY
R.R. SIEBERT CO.

R. R. Siebert Co., the originators of Dry Barrel Tumbling, and for over 30 years of pioneering research and development in the Plastic Industry, invite you to take advantage of their practical "KNOW HOW" concerning your problems connected with . . . processing and finishing all plastic Materials and plastic products of every description.

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DRY TUMBLING BARRELS

R.R. SIEBERT CO.
183 ST. PAUL STREET
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PROCESSES • COMPOUNDS
MATERIALS • EQUIPMENT
FOR FINISHING PLASTICS

KOLFLEX
QUALITY PLASTICIZERS

PHOSPHATES

Kolflex TCP—Tricresyl Phosphate
Kolflex CDP—Cresyl Diphenyl Phosphate

PHTHALATES

Kolflex DOP—Di(2-ethylhexyl) Phthalate
Kolflex DIOP—Di-isooctyl Phthalate
Kolflex DBP—Dibutyl Phthalate
Kolflex DDP—Didecyl Phthalate
Kolflex ODP—Isooctyl Decyl Phthalate
Kolflex BDP—Butyl Decyl Phthalate

KOLKER CHEMICAL CORPORATION
[illegible]

'924'
SEMI-AUTOMATIC PRESS
for compression molding

This self-contained semi-automatic press is one of a range of machines developed to meet the needs of manufacturers who want a press with its own pump unit, and only requiring the electrical connections to be made for starting up. It has a number of outstanding features, a few of which call for special mention.

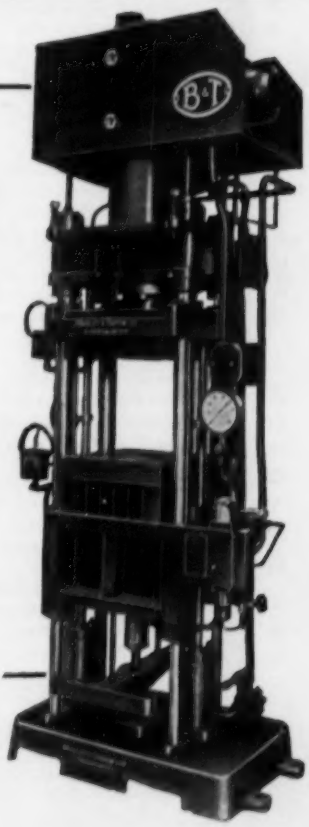
All movements of the press are controlled by a single lever control valve. It has a fast approach and return speed, with automatic change over to slow speed for the actual opening and closing of the mould. The point of changeover is easily adjustable to operate at any position of the stroke of the press.

The working pressure is variable and can be easily adjusted between maximum and minimum.

The illustration shows the press fitted with electric-heated platens.

Other manufactures include: Auto Control Presses. Pelleting Presses. Hydraulic Pumps. Hydraulic Accumulators. Hydraulic Valves. Automatic Molding Cycle Control Units.

B&T



Bradley & Turton Ltd
CALDWALL WORKS, KIDDERMINSTER, ENGLAND
Cables: "Wheels" Kidderminster, England

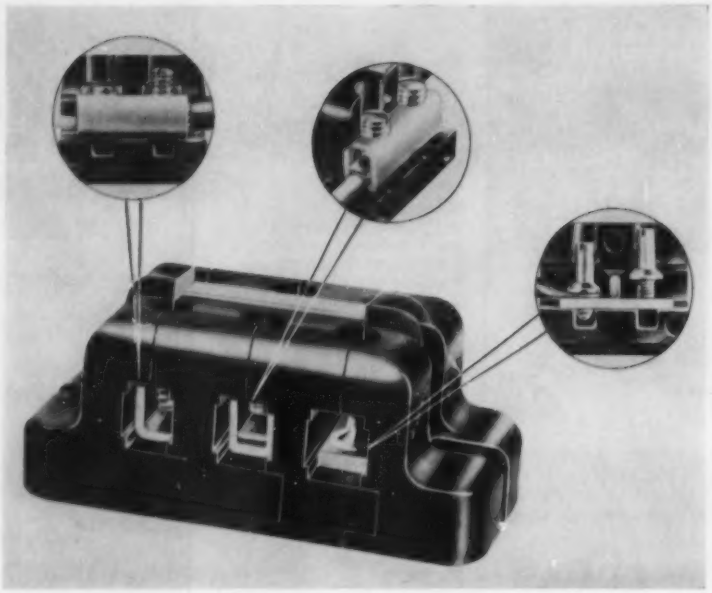
The Imperfect Heel

One weakness eventually destroyed the great warrior, Achilles (Greek God and ideal of strength and beauty). He was fatally wounded by an arrow which pierced his heel, *where alone he was vulnerable.* With a molded plastic product, a single weakness in the design of the mold, or fault in operation of equipment could spell failure for the product.

Lor-El engineers are able to produce intricate molds, flawless and perfect in every detail. *Lor-El's* modern high speed injection presses are manned by experienced, skillful operators. *Lor-El's* rigid quality control assures you of a quality molded plastic product, uniform in strength and appearance. *Lor-El* is vitally interested in pleasing you. What better way to do so than to design quality and success into your product. If your product requires a molded plastic component, feel free to call and discuss the problem with us. *Write today* for our brochure.

QUALITY CUSTOM MOLDING BY

Lor-El
COMPANY,
256 PATERSON PLANK ROAD
JERSEY CITY 7, N. J.



Three-circuit assembled terminal block showing tubular screw (left), tubular clamp (center), and strap screw contacts (right)

Phenolic circuit sections

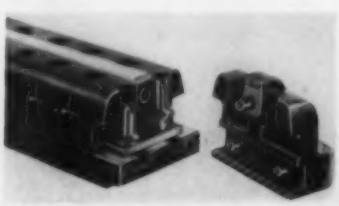
Molded phenolic circuit sections that snap easily and securely together are the key to a new type of electrical terminal block that provides the maximum in circuit flexibility.

Each of the phenolic sections is molded with a series of integral serrated locating pins that fit into corresponding holes molded into adjoining sections. Thus, an unlimited number of sections can be quickly assembled into a compact, rugged single-unit terminal block without the inherent disadvantages of conventional sectional blocks having accessory fastening hardware or loose fitting sections. The interlocking sections have also solved the problems of flash-over and leakage common to many types of conventionally assembled units. And in common with other phenolic terminal blocks, the assembled unit has good electrical characteristics, is resistant to moisture and solvents, and will operate satisfactorily at temperatures ranging from −65 to 300° F. All sections are interchangeable with conventional blocks of similar ratings.

For maximum flexibility in user application, the sections are made available for several assembly methods. Sections can be factory assembled; for volume users whose circuit length requirements vary, pneumatically or manually operated bench fixtures are available to facilitate in-plant assembly.

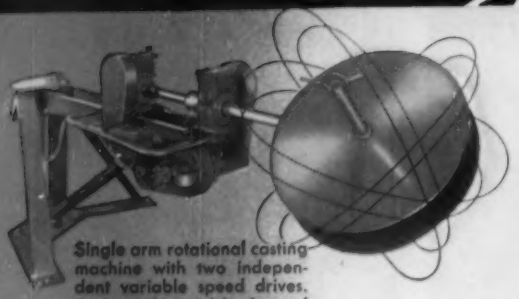
Three factory installed contact types—tubular screw, tubular clamp, and strap screw—are available for stripped- or terminal-ended wire; the contacts will accept a range of wire sizes from #18 through #4. All contacts are cadmium-plated electrolytic copper with positive stops.

Credits: Pres-Sure-Block terminal units manufactured by Buchanan Electrical Products Corp., Hillside, N. J.; phenolic supplied by Durez Plastics Div., Hooker Electrochemical Co., N. Tonawanda, N. Y.

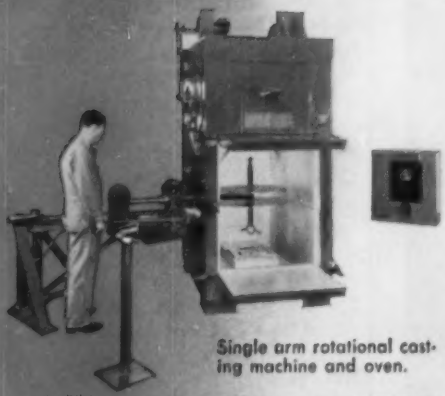


Assembled block showing integrally molded serrated pins and mating holes

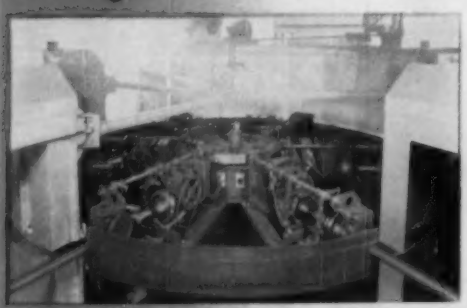
Announcing ... ROTATIONAL CASTING



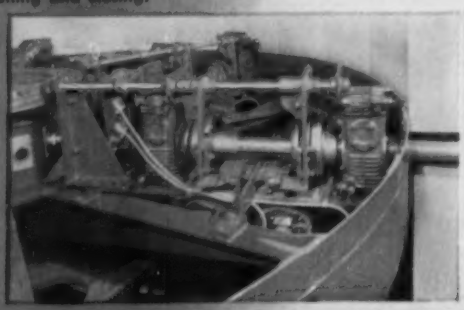
Single arm rotational casting machine with two independent variable speed drives. Automatic positioning of mold wheel for convenient mold servicing.



Single arm rotational casting machine and oven.



Multiple arm casting machine showing separate drive, clutches and brakes for mold rotation in each of the two planes. Designed for precise stopping necessary with automatic mold opening and closing.



Turntable style with six arms. An additional six arms can be added for a total of 12.

Significant Advance for Plastic Production

Machines engineered and built to your specific requirement. Following are some of the features built in our SPECIAL MACHINES.

Two groups of molds per arm, arranged for simultaneous rotation around two axes perpendicular with each other.

Two separate and variable speed drives rotate the molds around each axis. This action controls wall thickness for different product shapes.

Movement of arms is indexed for stop and go—not a continuous movement. Stopping time in oven or at the mold's service position can be varied.

Rotation of molds can be automatically stopped or started at service position and oven entrance.

Molds are automatically positioned for convenient opening, stripping, filling and closing.

A 30-inch diameter mold area allows a large range of mold sizes and flexibility of arrangement.

Arms, oven units and service stations can be added to increase capacity and mold servicing.

Sales and Engineering by

HALE and KULLGREN, INC.

P. O. Box 1231 · AKRON, OHIO

MANUFACTURED BY

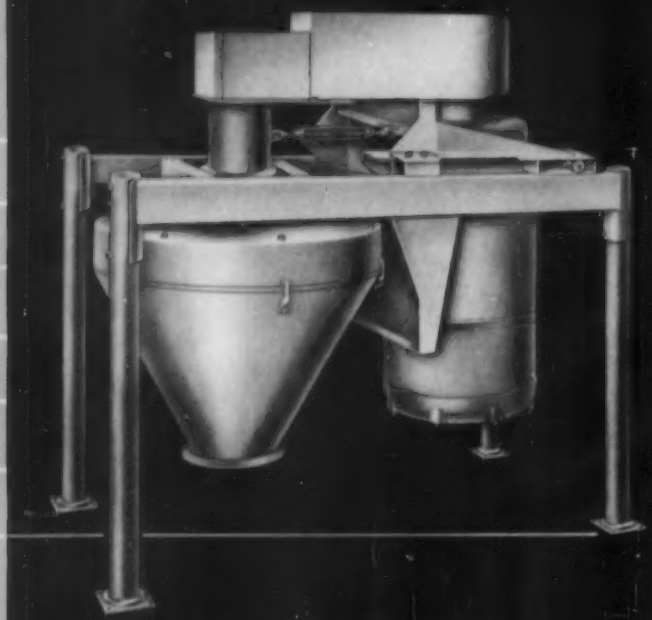
THE AETNA-STANDARD ENGINEERING CO., PITTSBURGH, PA.

PLANTS IN WARREN, OHIO · ELLWOOD CITY, PA.

Announcing...

the ENTOLETER®
40" SUPER IMPACT MILL

for applications requiring extreme impact velocity and/or ENORMOUS capacity



The Entoleter 40" Super Impact Mill is on display for the first time at the National Plastics Exposition . . . New York Coliseum, June 11-16 . . .

STOP... at Booths 617-621.

SEE... the latest in impact grinding and particle size reduction equipment.

LEARN... what it can do for you!

ENTOLETER DIVISION
SAFETY INDUSTRIES INC.
Formerly The Safety Car Heating and Lighting Co., Inc.
P. O. Box 904 New Haven 4, Conn.

Oxygen tent has formed styrene copolymer cabinet

Oxygen tent

Light weight, attractive appearance, durability, and resistance to dents, scratches, and abrasion were the main reasons for the selection of styrene copolymer sheet for the cabinet of a new low-cost portable oxygen tent.

Three sides of the cabinet are precision-formed from light blue sheet stock with a maize grain texture. The front section is formed from 0.093-in. material; the two side sections, with integrally formed louvers, are made from 0.062-in. sheet. Because of the close tolerances required, the sheets are preheated under carefully controlled conditions. Pneumatic gage-controlled presses and aluminum tooling are used for the forming operation. Pressures average 200 p.s.i.; cooling cycle is 15 minutes.

A flat panel with precision cutouts and one turned-up edge constitutes the back of the cabinet.

Designed to make the advantages of modern oxygen therapy more available to hospitals and nursing homes and for private use (through rental services), the low-cost portable tent weighs only 70 pounds. If desired, the unit can be hung from cribs or bed headboards.

Credits: Mechanette oxygen tent manufactured by O.E.M. Corp., East Norwalk, Conn.; cabinet is fabricated by Durable Formed Products, Inc., New York, N. Y., using Boltaron sheet supplied by Bolta Products Div., The General Tire & Rubber Co.

Reinforced acrylic

Panels press molded of fibrous glass-reinforced modified acrylic resin are the most recent of plastics glazing materials to be made available to the building trade.

Developed especially for industrial and commercial use, the glazing is shatterproof, weather resistant, extremely lightweight, and has excellent insulating qualities.

Available in translucent green or blue, or in clear, the 0.080-in. thick panels reduce glare as well as the heat of direct sunlight without reducing interior lighting efficiency. Because of their high impact strength, they can be installed more quickly and easily than glass and are less susceptible to breakage. As compared to reinforced polyester panels, the manufacturer makes the following claims for his material: 2.23 times greater weather resistance; 46.4% less color change; up to 50% more infra-red filtration (in some colors); and up to 100% greater load capacity.

The panels are available with smooth or pebbled surfaces either in flat sheet or corrugated form. Sizes range from 18 by 12 to 46 by 24 in.; fractional dimensioned sizes to meet individual requirements are also supplied in standard packaged units.

Credits: Structoglas glazing manufactured by Structoglas Div., International Molded Plastics, Inc., Cleveland, Ohio; Paraplex acrylic resin supplied by Rohm & Haas Co., Philadelphia, Pa.; fibrous glass supplied by Owens-Corning Fiberglas Corp., New York, N. Y.

Fibrous glass-reinforced acrylic panels for windows

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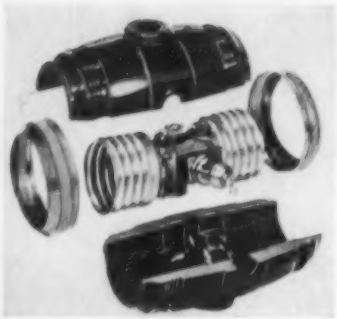

Exploded view of lamp holder showing phenolic housing and locking collars

Lamp holder

Simplicity and attractive yet functional design are achieved at low cost by molding the two-piece housing for a new twin lamp holder of phenolic.

The housing halves are transfer molded in a 150-ton press using pin-point gating. By keeping to extremely close tolerances in the construction of the six-cavity mold (including the design of the removable threaded plug located in each cavity for coring the threaded holes in the housing), all of the molded halves are completely interchangeable. The only finishing that is necessary on the phenolic parts is a short tumbling operation.

Because of the precision molding, the two halves of the housing fit snugly together over the switch and are held securely in place by brass collars that screw on to each end of the assembled housing. When the holder is being wired, the brass collars are removed and the two phenolic parts separated to expose the terminals.

In operation, the twin lamp holder provides versatility in three-way lighting through alternate control of two single-filament lamps of different wattages. When equipped with a 50-w. and a 100-w. lamp, for example, either can be turned on separately or both at one time.

Credits: Twin lamp holder manufactured by McGill Mfg. Co., Inc., Valparaiso, Ind.; parts molded by Tietz & Baur Plastics, Inc., Melrose Park, Ill., using phenolic supplied by Durez Plastics Div., Hooker Electrochemical Co., North Tonawanda, N. Y.

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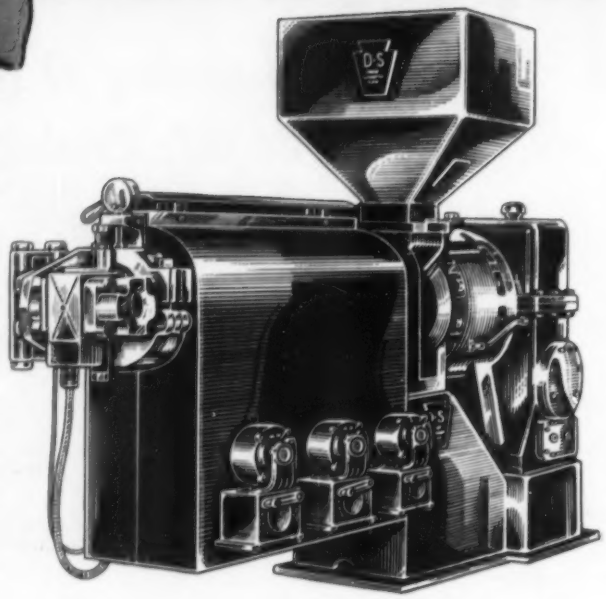
Some STATISTICS on the *THERMA-FIN* EXTRUDER*

In recent months numerous congratulatory messages have been received by Davis-Standard from customers who have only the highest praise for the performance of THERMA-FIN Extruders.* Predominant among the list of enlightening comments that have been expressed is one concerning the excellent temperature control of THERMA-FIN Extruders,* even under the most difficult operating conditions.

Such response is the direct result of the efforts made by Davis-Standard's engineers to design a temperature control system that had more than adequate heating and cooling capacities for a variety of extruder applications.

Statistics on the heating and cooling capacities of standard THERMA-FIN Extruders* are tabulated below.



*U. S. Patents Pending

Extruder Bore Size (inches)	Heating Capacity (watts)				Cooling Capacity		
	Head Zone	Cylinder Zones**			Indiv. Blower Cap. (cu. ft./min.) Per Cylinder Zone	Total Heat Radiation Surface (sq. in.)	
		No. 1	No. 2	No. 3		Standard Mach.	Super Mach.
1-½	1000	2500	2500	X	560	1800	X
2	1000	3600	3600	3600	560	3100	4650
2-½	1500	6000	6000	6000	560	6150	8200
3-¼	1500	5000	4000	4000	920	6925	9035
4-½	2000	7000	5000	5000	920	9000	11,700
6	2500	9500	7000	7000	920	11,500	14,850

**Last zone is closest to the feed throat. For super machines, an additional zone is added with same capacity as the last zone.*

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Nylon bellows in explosion suppression device

Excellent resistance to chemicals, corrosion, and heat; the ability to retain resiliency and low spring rate at extremely low temperatures; and low specific gravity combine to make nylon film the ideal material for the fabrication of a bellows diaphragm used in a device for sensing and suppressing explosions in jet aircraft fuel tanks.

The design of the explosion suppression system is based on the fact that, in the initial stages of any explosion or fire, the rise in pressure is not instantaneous, but occurs over a period of three to four milliseconds. If they can be applied during this brief time, suppressants can effectively dampen the incipient explosion before it does damage to the tank or aircraft.

The device which performs this function incorporates a gas-filled bellows fabricated from extruded nylon film. The rise in pressure caused by the incipient stage of an explosion in a gas tank compresses the bellows and the movement of its diaphragm triggers off an electric current to a small detonator located within a capsule containing a suppressant agent (generally bromochloromethane). As the detonator explodes, the suppressant is scattered in the form of a mist, cools the inside atmosphere of the tank, and renders inert the unburned vapors around the expanding flame front, thus aborting the explosion.

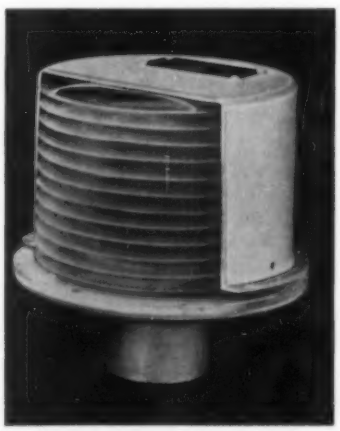
The bellows is fabricated of 8-mil flat extruded nylon film. A number of rings are punched out of the film and joined together at alternate inside and outside diameters by electronically heat-sealing the edges at high frequency. One end of the bellows is sealed with a disk of the same nylon film and the last ring on the open end of the bellows is ½ in. wider than the others, so that it forms a flange. A number of mounting holes are die-cut in the perimeter of this flange and aluminum rivets inserted through these holes attach the bellows to the housing which encloses the bellows.

Other materials tested for use in the bellows failed to operate properly. Rubber, for example, was found to deteriorate upon prolonged contact with the jet fuel. Metals were found to be too rigid and, since the response time of the bellows must approach zero, were not sensitive enough to provide the split-second timing required to do the job.

Nylon, because of its low inertia, resulting from its resiliency and its low specific gravity, responds immediately and proved to be the most practical material for this application. The resistance of nylon to corrosion while at the same time withstanding the operating temperatures in jet fuel tanks was an added advantage in its favor.

In addition to jet aircraft, suppression systems have also been installed successfully in a number of non-aircraft industrial applications.

Other possible applications for the device might include protection of high-speed printing presses, fuel test cells, flour mills, and similar equipment and areas where hazards due to explosive atmospheres exist.



Cutaway view showing nylon bellows in explosion suppression device

Credits: Explosion and fire suppression system manufactured by Simmonds Aerocessories, Inc., Tarrytown, N. Y.; bellows fabricated by Plastex Process Co., Maywood, N. J.; Zytel 63 nylon resin supplied by Du Pont

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When you're at the New York Coliseum for the Plastics Show, look up at the plastic* lighting panels for one example of the quality *custom vacuum forming* done by Plastic Enterprises.

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Vinyl safety markers are produced in a variety of designs, are easily cemented in place on road surfaces

Safety markers

Calendered vinyl sheeting is now being used in the production of a new type of highway marker for designating guide lines for pedestrian and vehicular traffic and for indicating curves, hills, traffic signals, etc.

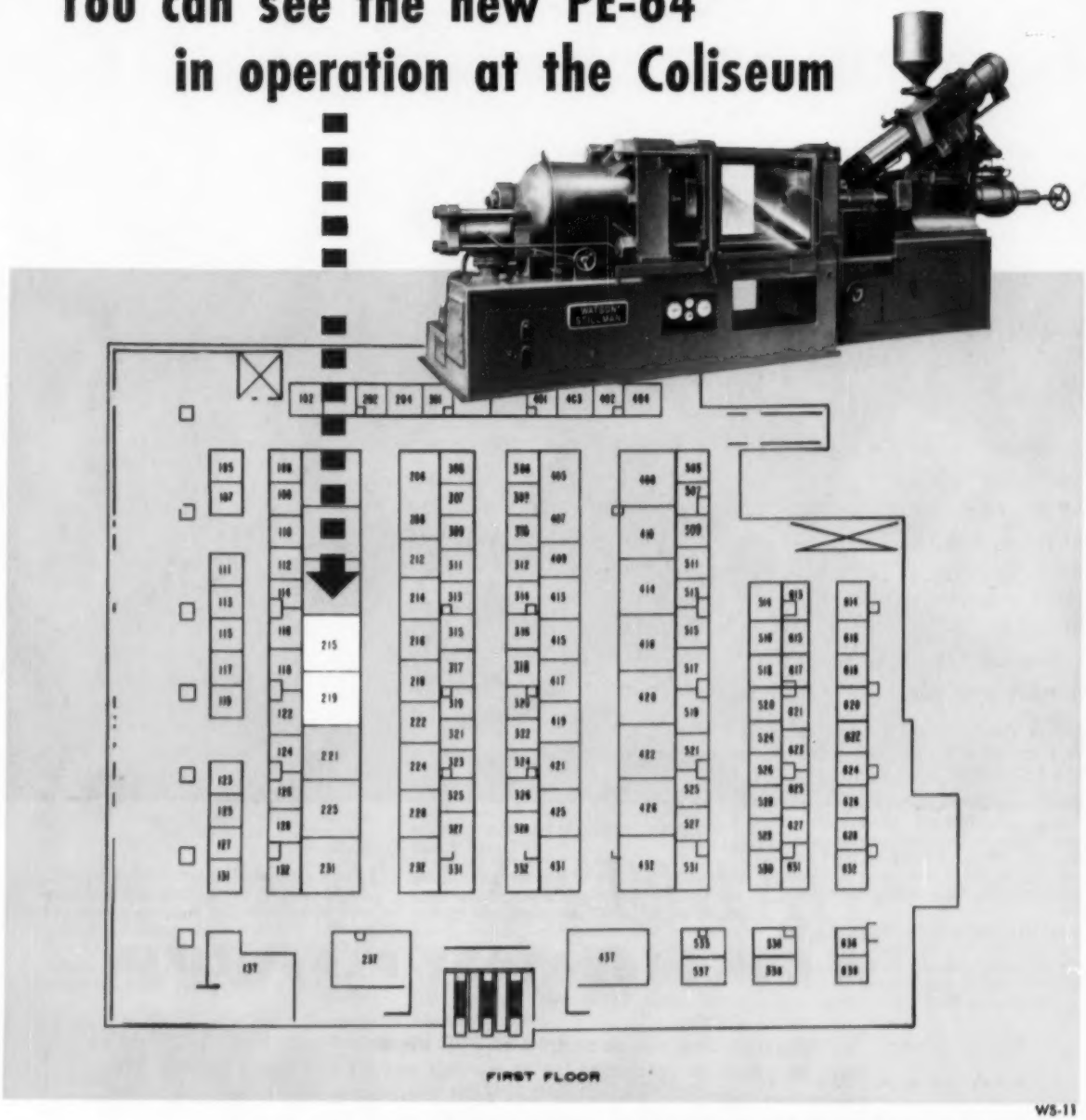
The markers are die-cut from a specially formulated 0.042-in. vinyl sheeting. It is claimed to bond to surfaces with a greater strength than heretofore shown by other materials used for the application—thus reducing the possibilities of dislocation or cracking under heavy traffic. A cold adhesive is simply applied by brush to the undersurface of the marker and to the area to be covered; foot or hand pressure are sufficient to fasten the markers securely in place on surfaces of concrete, bituminous, or block construction.

Because the markers are fabricated from such thin-gage sheet there is little chance that they will accidentally be uprooted by snow plows. Other advantages of the vinyl markers: they will not embrittle at temperatures as low as −25° F. and will not soften at temperatures as high as 150° F.; they are resistant to water, gasoline, kerosene, and crankcase drippings; and they have a tear resistance of 100 p.s.i.

Available in highly visible white or yellow, the markers can be die-cut in a variety of sizes and shapes to meet individual requirements.

Credits: Miller Safety Marker manufactured by The Miller Co., Harrisburg, Pa.; Vanadex vinyl sheeting developed by The Miller Co., in cooperation with Congoleum-Nairn laboratories.

You can see the new PE-64 in operation at the Coliseum



WS-11

Point of interest at the coming 7th National Plastics Exposition will be the Watson-Stillman exhibit — to occupy the booths shown in white above. The company's new PE-64 horizontal preplasticizing type injection molding machine will be on display, going through its paces, and actually molding.

This exciting addition to the Watson-Stillman line has more modern features than any other machine of its type. Among these are an improved base design which provides accessibility to the entire pumping unit; a new heating cylinder for better plasticizing at lower temperatures; a preplasticizing unit that assures shorter molding cycles, better control of shot thickness, lower injection pressures and greater uniformity in material and coloring.

Find out for yourself how the PE-64 compares. Drop in and see us at the show. Remember: Booths 215 & 219, N. Y. Coliseum, June 11-15th.

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Manufacturers of plastic products or plastisols that must be extraction resistant will be interested in testing HARFLEX® 300. Samples of HARFLEX® 300 for test or experimental work are available. Write for our free Technical Bulletin #1002-H which gives full information about this easy processing and efficient plasticizer.

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REINFORCED MOLDING COMPOUNDS. Data sheets give technical information on company's line of preimpregnated glass fiber molding compounds. Cover physical, chemical, electrical and mechanical properties. Price lists included. Thermaflow Chemical Corp. **(F-601)**

POLYVINYL CHLORIDE. Technical bulletin gives properties and application data for "Diamond PVC-50," a polyvinyl chloride resin specifically designed for extrusion and special calendering operations. Diamond Alkali Company. **(F-602)**

GAS-EXPANDED POLYURETHANE FOAM PLASTICS. Bulletin gives technical information about company's "Collo Allfoam" thermoset cellular plastic materials. Discusses chemical and physical properties and describes applications. Lists available stock sheet and block forms. American Collo Corp. **(F-603)**

SCREEN PROCESS DRYER. Specification sheet describes company's "Screen Process Thermo-Jet Dryer," a unit for high speed drying of inks, coatings, and adhesives. Discusses operating features and gives dimensions. General Research & Supply Co. **(F-604)**

PHENOLIC RESINS. File folder contains series of technical reports on company's phenolic resins for laminating, casting, and tooling. The Marblette Corporation. **(F-605)**

ENGRAVING EQUIPMENT. Illustrated catalog describes company's 2- or 3- dimensional engraver, a portable unit suitable for decorating, lettering, model-making. Catalog also covers a wide range of special attachments, shows type faces available for lettering. Mico Instrument Company. **(F-606)**

HYDRAULIC PRESSES. Illustrated literature lists detailed specifications and dimensions of line of 4-column, down-acting hydraulic presses with from 25 to 200 tons capacity. Hydraulics Division, K. R. Wilson Incorporated. **(F-607)**

POWER SPRAY GUNS. Illustrated 16-page catalog covers company's line of spray equipment for coating, lacquering, painting. Includes functional diagrams, gives full information on accessories: hose, swivels, filters, spray heads. Lincoln Engineering Company. **(F-608)**

TECHNICAL DATA ON MOLDING COMPOUNDS. 88-page book gives technical information concerning the physical, chemical and electrical properties of the company's extensive line of Fiberite high impact phenolic molding compounds including detailed molding data for each. The Fiberite Corporation. **(F-609)**

MIXERS. Illustrated catalog covers company's line of mixing machines, suitable for mixing plastics. Discusses operating features and includes specifications. Mixing capacity of machines range from one gallon to 300 gallons. Paul O. Abbé, Inc. **(F-610)**

MOLD TEMPERATURE CONTROL. Bulletin describes company's mold temperature control unit, suitable for injection molding, vacuum forming and sheet extrusion operations. Gives specifications and discusses features. Sterling, Inc. **(F-611)**

"PLIOVIC G60V" MANUAL. Technical description of this polyvinyl chloride resin, designed for low temperature processing. Gives physical properties, lists compatible plasticizers and stabilizers. Gives detailed compounding and calendering data. The Goodyear Tire & Rubber Company. **(F-612)**

PLASTICS FABRICATION. Illustrated booklet discusses wide range of custom decorating, printing, hot stamping and engraving operations that the company is equipped to perform on plastics, sheet, tube, or rod stock. Plasticraft Products Company. **(F-613)**

STAMPING AND MARKING EQUIPMENT. Folder describes company's line of hot stamping and marking equipment. Discusses operations handled by the machinery. Cover illustrates gold leaf stamping. Peerless Roll Leaf Company. **(F-614)**

MIXERS. 12-page illustrated catalog describes company's line of intensive mixers, suitable for plastics. Includes cutaway illustrations of working parts, along with specifications and diagrams. Stewart Boiling & Co., Inc. **(F-615)**

DIAMOND COMPOUNDS FOR FINE GRINDING AND POLISHING. Illustrated folder describes equipment suitable for polishing plastic molds, hobbs, and dies by use of diamond powder. Discusses operation of applicator and filling cartridge. Selection chart lists compounds suitable for particular purposes. Hypres Division, Engis Equipment Co. **(F-616)**

CHEMICALS FOR THE PROCESS INDUSTRIES. 32-page booklet covers the company's chemicals prepared for processors, including those in the plastics industry. Covers such information as type of shipping containers, technical data, and uses. Manufacturers Chemicals Department, American Cyanamid Co. **(F-617)**

EXTRUDING EQUIPMENT. Illustrated literature lists specifications and describes company's full line of thermoplastics extruders and accessories. National Rubber Machinery Co. **(F-618)**

SMALL HYDRAULIC PRESSES. Catalog gives detailed facts and photos on company's line of small air-powered "Hydrolair" hydraulic compression presses. 30, 50, 75, and 100 ton models are available. Detailed specifications and optional modifications are also given. Elmes Engineering Division, American Steel Foundries. **(F-619)**

CATALOG FOR INJECTION MOLDERS. 65-page illustrated catalog gives complete specifications and prices for line of grinders, heating cylinders, nozzels, drum tumblers, and other injection molding accessory equipment. Injection Molders Supply Company. **(F-620)**

CORROSION RESISTANT PIPE. Catalog illustrated with schematic drawings gives detailed specifications for line of "Agile" corrosion-proof thermoplastic pipe, fittings, valves, tubing and ducting, and gives the properties of the five plastic materials from which the piping is produced. American Agile Corporation. **(F-621)**

DRY COLORING. Folder suggests procedures and equipment to be used in the dry coloring of molding compounds. Information on company's line of colorants and dispersants is included. Plastics Color Co. **(F-622)**

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EQUIPMENT • SUPPLIES • SERVICES

VINYL PLASTICIZER. Technical data sheets present detailed descriptions of di-isodecyl phthalate (DIDP), described as being an economical vinyl plasticizer in formulations requiring low volatility and good permanence. Includes data on applications, suggested formulations and performance. Pittsburgh Coke & Chemical Co. (F-623)

MAGNETIC SEPARATORS. Illustrated brochure describes company's line of magnetic drum separators. Discusses operating methods, and gives full specifications along with diagrams. Dings Magnetic Separator Co. (F-624)

PLASTIC EXTRUDER MAINTENANCE. Technical bulletin discusses the economics of extruder operation, operational efficiency, and the proper selection of extruder size, relating these factors to the Prodex line of extruders. Graphs show relationship between product weights and output weights. Prodex Corp. (F-625)

HEAT EMBOSSING. Application report discusses heating of polyvinyl chloride web fed film stock during embossing operations. Describes the heating mechanism used, and discusses results and advantages. Edwin L. Wiegand Company. (F-626)

SAW BLADES. Folder describes company's "thin rim" carbon tipped saw blades, suitable for cutting plastic materials. Includes specifications and pointers for productive use and good maintenance. Deluxe Saw & Tool Company. (F-627)

ALKYD MOLDING COMPOUNDS. 8-page brochure gives technical information about company's "Plaskon" alkyd molding compounds. Covers presses and equipment suitable for these materials, along with the proper use of molds. Discusses preheating, preforming and storage. Barrett Division, Allied Chemical & Dye Corporation. (F-628)

MARKING DIE CATALOG. Illustrated catalog describes company's extensive line of steel marking dies. Includes a section explaining how impressions are measured and controlled. Contains charts of characters available, shown in actual sizes. The Jas. H. Matthews Company. (F-629)

ELECTRIC HEATING ELEMENTS. 24-page illustrated catalog describes company's line of rod, tubular and strip heating elements. Gives extensive application data. Includes specifications and diagrams. Cutler-Hammer Co. (F-630)

DRYERS AND FUSERS. 12-page illustrated brochure covers company's drying and fusing equipment with special applications in the manufacture of supported films and coatings. Describes operation of machines, and illustrates applications. F. C. Dawson Engineering Co. (F-631)

ROUND KNIFE CUTTER. Illustrated bulletin describes line of rotary knife cutting machines suitable for cutting plastic film and sheeting, glass mat, etc. Eastman Machine Co. (F-632)

HYDRAULIC PRESSES. Illustrated folder describes line of imported hydraulic platen presses. Gives specifications and suggested applications. Karlton Machinery Corp. (F-633)

WIRE COATING. Technical paper describes processing details relating to the coating of copper wire with plastisols, insulating varnishes, enamels and decorative finishes. C. A. Litzler Company. (F-634)

BALSA WOOD. Twenty page booklet describes the production, processing and applications for this light-weight wood material having application as core stock in reinforced plastics constructions. Mechanical properties included. International Balsa Corporation. (F-635)

ACRYLIC FOR LIGHTING. Twelve page booklet describes the properties of acrylic materials and applications for acrylics in the field of lighting. Includes chart giving physical, thermal, dielectric and optical characteristics. E. I. DuPont de Nemours Co., Inc. (F-636)

ELECTRIC MOTORS. Illustrated brochure describes company's line of "V-S Drive" motors, designed for a wide range of industrial uses. Discusses speed ranges and speed shifts. Gives specifications. Describes various control features. Reliance Electric and Engineering Co. (F-637)

DRILLING BUR SELECTOR CHART. Large wall chart, 18¾"x27⅞", contains operating information, specifications, and illustrations of more than 120 standard "Atrax" solid tungsten carbide burs. Includes a recommended speeds table that gives correct bur and RPM data for most efficient work on a wide range of metals. Atrax Company. (F-638)

VINYL PLASTICIZER. Technical data bulletin gives detailed information on "Harflex 300," described as an all-polymeric, permanent plastizer for vinyl. Data on properties, compatibilities, compounding and applications are included. Harchem Division. (F-639)

PHENOLIC-IMPREGNATED MATERIAL. 16-page catalog gives detailed technical information and specification tables for "Celoron," a phenolic-impregnated material available in sheet, molded-laminated, molded-macerated, and laminated-macerated forms, suitable for fabricating, injection and transfer molding. Continental-Diamond Fiber Division. (F-640)

INJECTION MOLDING PRESSES. Six-page catalog describes features, operating characteristics, capacities and specifications of line of injection presses in models having capacities of 1.4, 2.1, and 5.2 ounces per shot. Sommer. (F-641)

HYDRAULIC PRESSES. 40-page catalog illustrates, describes features and gives detailed specifications on extensive line of hydraulic compression, hobbing, hot plate, transfer and special purpose presses. Clifton Hydraulic Press Co. (F-642)

INSERTS FOR MOLDED PLASTICS. 4-page bulletin describes features and gives instructions for application of a hand- or machine-fed metal expansion insert said to have torque and pull strength comparable to that of molded-in inserts. The Phelps Manufacturing Company. (F-643)

ADDITIVES FOR VINYLS. 26-page technical bulletin describes properties and gives performance data on company's line of plasticizers, stabilizers, and bodying agents for polyvinyl chloride resins. The Baker Castor Oil Company. (F-644)

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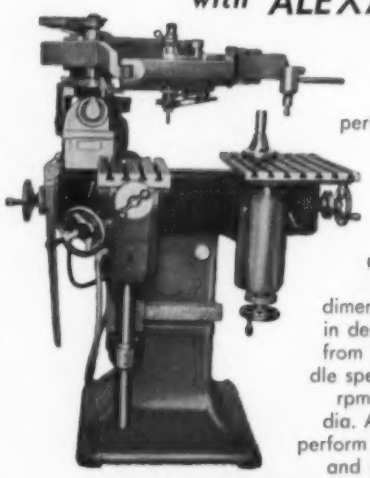

Combining precision performance with rugged construction, this latest model, No. 3A, copies the finest details—yet handles dies and molds up to 1,000 lbs. It is used for 2 and 3 dimensional work. Versatile in design, it employs ratios from 1.5:1 to 10:1—14 spindle speeds from 475 to 9500 rpm—cutters up to 3/8" in dia. Adjustable spindle can perform both heavy roughing and minute finishing operations. Also available in smaller sizes 1A and 2A. Prompt delivery—large stock of spare parts.

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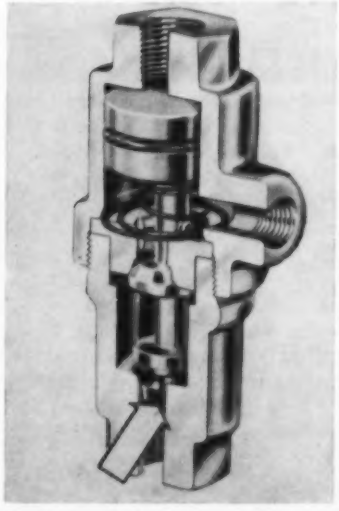
The function of the valve, which has only two moving parts —the one-piece nylon spindle and an aluminum seat—is to maintain clean, dry, and oil-free air in air tanks by discharging water, oil, carbon, and sludge from the system. The valve has already been successfully used in air equipment for trucks, tractors, buses, garage equipment, and diesel locomotives.

In contrast to brass spindles which wore in ridges when fit into the aluminum seat, the nylon spindles have shown no appreciable wear even after extensive use. Because of this toughness, a narrower seat face can be employed to accommodate the spindle. By thus reducing the space between spindle and seat, the possibilities of scale particles being caught under the seat are minimized.

Credits: Ejector valve manufactured by George Mfg. Co., Philadelphia, Pa.; nylon spindle molded by Philadelphia Plastics & Mfg. Co., Philadelphia, Pa.; nylon supplied by Du Pont.



Cutaway of ejector valve with nylon spindle (arrow)

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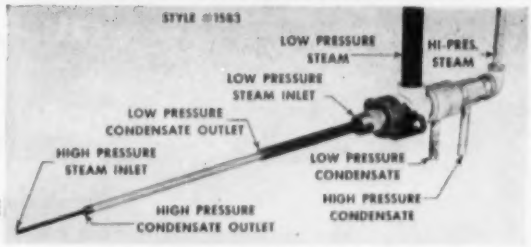

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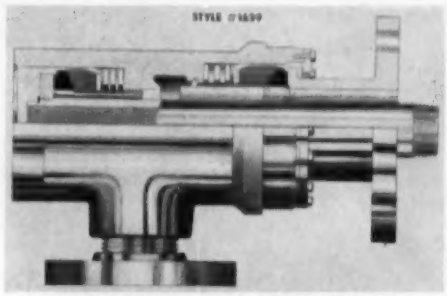

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POLYVINYL CHLORIDE. Technical bulletin gives properties and application data for "Diamond PVC-50," a polyvinyl chloride resin specifically designed for extrusion and special calendering operations. Diamond Alkali Company. (F-602)

PLASTICS FABRICATION. Illustrated booklet discusses wide range of custom decorating, printing, hot stamping and engraving operations that the company is equipped to perform on plastics, sheet, tube, or rod stock. Plasticraft Products Company. (F-613)

MIXERS. 12-page illustrated catalog describes company's line of intensive mixers, suitable for plastics. Includes cutaway illustrations of working parts, along with specifications and diagrams. Stewart Bolling & Co., Inc. (F-615)

HEAT EMBOSSING. Application report discusses heating of polyvinyl chloride web fed film stock during embossing operations. Describes the heating mechanism used, and discusses results and advantages. Edwin L. Wiegand Company. (F-626)

ROUND KNIFE CUTTER. Illustrated bulletin describes line of rotary knife cutting machines suitable for cutting plastic film and sheeting, glass mat, etc. Eastman Machine Co. (F-632)

HYDRAULIC PRESSES. Forty page catalog illustrates, describes features and gives detailed specifications on extensive line of hydraulic compression, hobbing, hot plate, transfer and special purpose presses. Clifton Hydraulic Press Co. (F-642)

Any of the booklets described here, plus many others—forty-four in all—are available for the asking, without charge or obligation.

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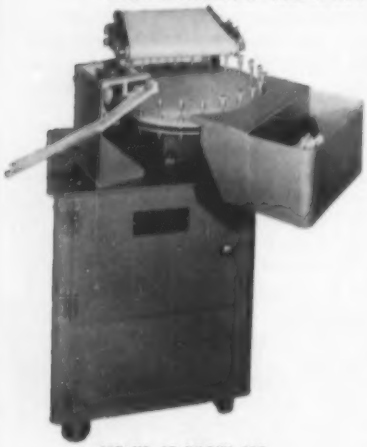

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Plastic sandwich panel is curtain wall for building

Sandwich panel

Good structural strength coupled with outstanding insulating qualities and low cost of maintenance and installation marks the use of a plastic sandwich panel for the outside walls of an 8480-sq. ft. plant recently erected for the Burke E. Porter Machinery Co. in Grand Rapids, Mich.

The 2¼ in. thick panels for the curtain walls consist of skins of 0.018 in. thick polyester-fibrous glass laminate and a core of foamed styrene of 2-lb. density. A sheet of ⅛ in. thick cement asbestos board separates the skin from the core.

The steel frame of the building is especially designed to accommodate the 4- by 8-ft. sandwich panels. The bottom of each of the plastic panels is grooved to fit into a steel spline in the base plate of the frame and is sealed in place with tar-base mastic. Panels are joined together with splines of foamed styrene of 4½-lb. density which are inserted into the panel edge joints to provide an air-tight and water-tight structure. The entire curtain wall for the building was hung in 85 man-hours.

In addition to the speed and low cost of their installation, the sandwich curtain walls are strong, highly resistant to impact, impervious to moisture and vermin, rotproof, non-corrosive, and non-warping. The opaque faces of the panels need no painting or other surface protection.

Credit: Hasko-Struct panels manufactured by Haskelite Mfg. Corp., Grand Rapids, Mich.

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Portable X-ray unit molded of phenolic

Molded phenolic components play an important role in the design of a new portable X-ray unit which loads, exposes, and develops film in daylight. The unit is intended to be used with a portable X-ray generator for providing on-the-spot radiographs to help find hidden flaws in metal castings, bridge girders, piping, pressure vessels, etc.

The mechanical strength and resistance to chemicals (including the acid and alkali photographic solutions used in the unit) which phenolic possesses make it an ideal material for the application. In addition, the close tolerances needed to exclude light from the photosensitive film are maintained by the excellent molding properties and dimensional stability of the material.

Three interlocking molded units make up the principal functional parts of the system: film dispenser, film holder, and film processing unit.

Phenolic dispenser unit stores, dispenses film to . . .

. . . phenolic film holder (above), which supports film for exposure. Exposed film is developed in phenolic processing unit (right)

The film dispenser which holds a canister loaded with 24 films is the major plastics component. It is produced of rag-filled phenolic with a molded-in cavity that accommodates the canister. The film holder, which is integrated with the dispensing unit, receives film from the dispenser (a locking device in the dispenser safeguards against more than one film being loaded at a time) and holds it in the proper position during exposure.

Exposed film is unloaded directly from the holder into the third plastics component—the film processing unit. The insertion of the film holder into this unit forces back a spring-loaded shutter and allows the film to drop into the processing tank. Without removing the film from the processing unit, standard developing and fixing solutions are poured through a spout into the tank. The entire time required to develop the exposed radiograph is only six minutes.

Removing the film holder automatically returns the shutter to its former position, thus completely preventing the entrance of light.

Since the portable X-ray unit is generally carried out into the field, the fact that the molded parts will resist rough use and wide extremes of temperature and climate plus the fact that it can be used with standard equipment, has played an important part in the success of the application.

Credits: X-ray unit manufactured by Ind-X System, Inc., Seattle, Wash.; molded by Sulak Mfg. Co., Seattle, Wash.; phenolic resin supplied by Bakelite Co., a Div. of Union Carbide and Carbon Corp., New York, N. Y.

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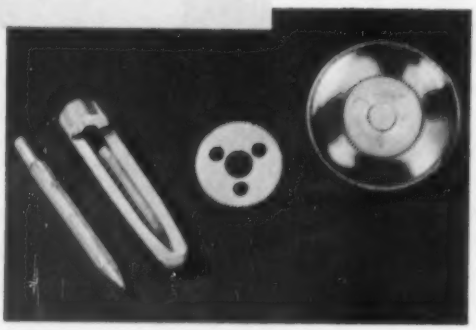

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Materials

(*From pp.* 155-163)

ticular property such as elasticity, better aging, higher temperature resistance, various degrees of toughness, or elimination of creep. In other words, the properties of two polymers are built into one. Such materials will probably always be more expensive than comparatively simple copolymers, but the results will warrant the extra cost. This principle applies to many plastics but is particularly applicable to vinyls. There should be definite adaptation of the graft polymer system in vinyls during the next five years and they may contribute immensely to a broadening of the market since they will produce a resin more suitable for certain applications.

On the other hand, the new Phillips- and Ziegler-type catalysts which may create revolutionary developments in other phases of plastics are apparently of no use whatsoever to improvement of the vinyl breed. They tear vinyls to pieces.

Vinyl producers are also approaching vinyl chloride polymer improvement from still another angle. Their feeling is that straight P.V.C. will always loom largest in the vinyl chloride market; therefore, the thing to do is to improve that resin without adding other materials. Consequently, they are working toward improvement of unplasticized polyvinyl chloride resins, particularly toward making it more workable and flexible in thin sections.

The stiffness of unplasticized vinyl is directly proportional to the cube of its thickness. Thus, doubling the thickness raises stiffness by a factor of eight. It is obvious, then, that thinness is a desirable quality in maintaining flexibility or workability. For example, if a section of vinyl wire coating is reduced from $\frac{5}{32}$ to $\frac{5}{64}$ in., it will be only $\frac{1}{8}$ as stiff. Plasticizers reduce dielectric properties. But with reduced thickness, less plasticizer is needed to achieve flexibility. Hence there is a counterbalancing feature to achieve good electrical properties. Relatively un-

plasticized, thin-section flexible vinyl has remarkable properties. Its temperature resistance approaches polyethylene for low-temperature brittleness and increases over polyethylene or plasticized vinyl for high-temperature resistance.

The major properties added to P.V.C. by plasticization are elongation and processing efficiency. Present desire is to produce an unplasticized vinyl that can match these properties and thus capitalize on the inherent properties of 100% vinyl resin unfettered by the addition of materials which nearly always affect the material. Much of the development work in this direction is based on learning how to extrude and process a thin section of a fairly rigid compound. That this work has gone far beyond the "test-tube" stage is indicated by laboratory samples of items molded of unplasticized vinyl produced by one company which, as yet, is not ready to reveal details of the work it is doing in this field.

Other vinyls

The "other vinyls" in the Table on p. 156 are saran, vinyl acetate, butyral, alcohol, formal, carbazole, ethers, and esters. Vinyl acetate is the big gun in this list. Its largest upsurge is expected to come from an ever increasing demand for surface coatings, although growth in adhesives is steady. The coatings field is expected to expand rapidly in the next two or three years even though styrene-butadiene latex competitors claim there will be a price differential in favor of their material. Even paint producers seem puzzled over which of the three current latex formulations will be most widely used in the future. There are scores of different resins suggested for paints, varnishes, and lacquers. Perhaps some of the new olefins will also move into the field before 1960. A wild guess on the future for paint resins is just as likely to be accurate as a reasonable estimate based on present knowledge of the paint industry.

Polyvinyl butyral, the core of safety glass, will grow as the need for such glass increases. Except for specialty coatings there are no other big uses for butyral on

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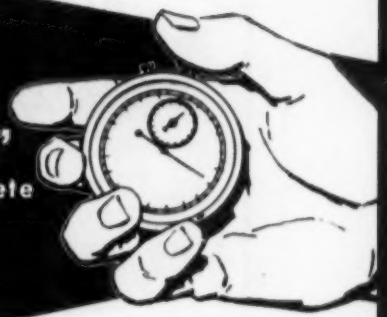

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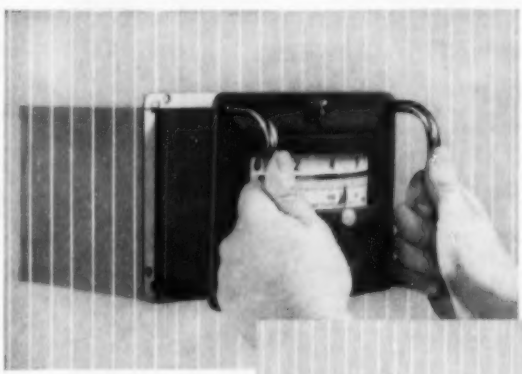

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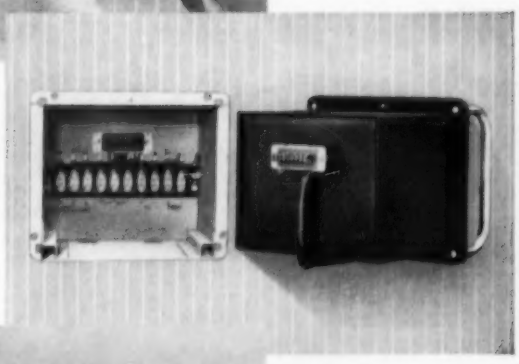

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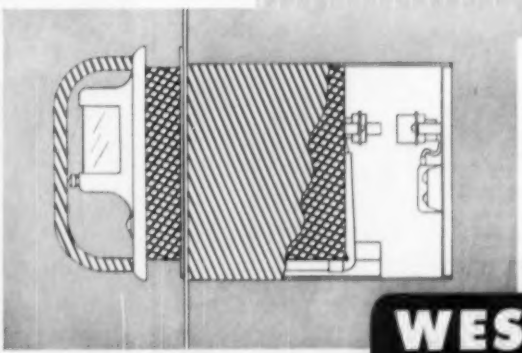

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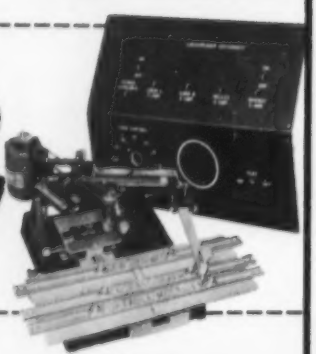

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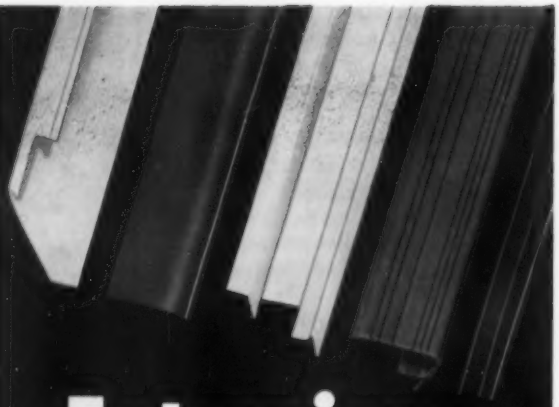

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Foam Plastics

the horizon. Saran has had various growing pains over the past 10 years. Screen cloth, seat covers, and Saran-Wrap have all had a year or two of big volume sales but then leveled off rather suddenly. Saran film has extraordinary properties as a packaging film that may find much bigger markets in the future. Vinyl ethers were once thought to have great possibilities as adhesives but so far have been quiescent. Vinyl esters such as vinyl propionate have good possibilities as copolymers with other vinyls, but they are too new for evaluation as to future progress. They impart flexibility to other resins and could help to reduce the need for plasticizers.

The alkyd and rosin-modified esters are paint resins. They have been growing steadily but not furiously since 1940. Competition from other resins has perhaps interfered with alkyd growth and may interfere even more as they are developed to fit the needs of future markets.

Polyethylene

Polyethylene has been the most publicized of the large volume plastics and has by far the biggest percentage growth in the past five years. Sales grew from 200 million lb. in 1954 to almost 350 million in 1955. If polyethylene adds 150 million lb. a year in each of the next five years, as it did in 1955, it will go over a billion pounds in 1960; but market analysts find it difficult to determine just where all this market growth will come from.

Yet that billion-lb. volume is by no means fantastic. Monsanto estimates that at least 225 million lb. of film will be used for packaging alone in 1960—and that could be a conservative estimate. Improved clarity, better printing surface, improved techniques for gluing and handling on packaging machines, and coating or laminating a polyethylene film on other materials to give combined properties are all factors working toward a greater invasion of the packaging field by polyethylene film.

In the past year another unusually large market has been opened for polyethylene film;

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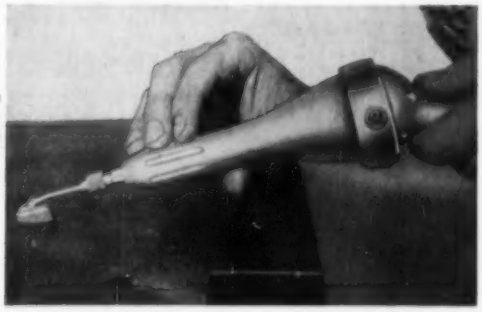

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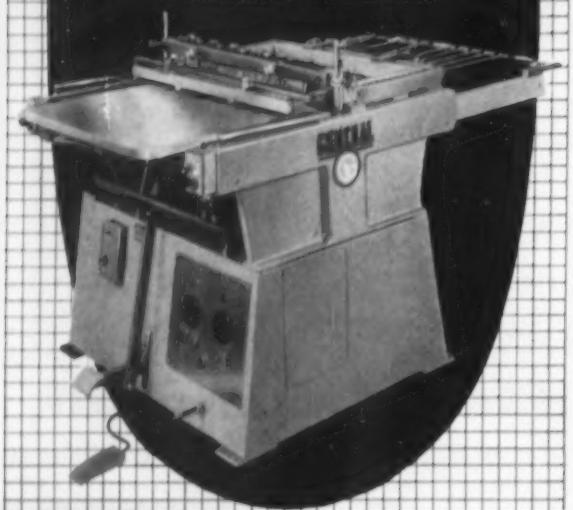

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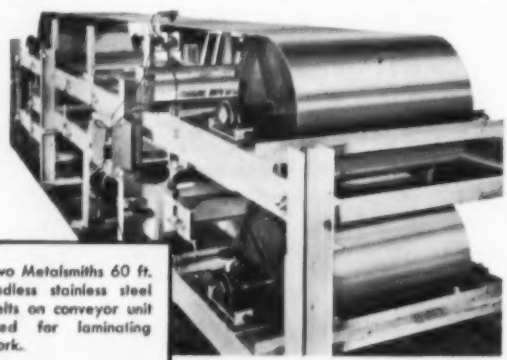

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contractors are using it as a covering for buildings under construction and as vapor barriers in floors and walls. Its use in concrete highway construction, both as an underlay and to aid curing, is another construction use. Who is bold enough to suggest how large these uses may become? In the agricultural field polyethylene has vast potential as a mulch to inhibit weed growth. Tarpaulins for scores of purposes could consume millions of pounds. One company goes so far as to estimate that the total 1960 market for film alone will reach 800 million pounds.

Other uses for polyethylene are also showing rapidly rising growth curves. Electrical applications in particular are promising, with every indication of even faster growth in the future. The stiffer polyethylenes will add to the base, especially in molding applications where their greater stiffness, heat resistance, and surface gloss are desirable. Bottle makers are fairly drooling at the mouth about the new material. They think it may even make polyethylene milk bottles a feasible product. For more details on these present and future applications of the fastest growing member of the plastics family see MODERN PLASTICS, September, October, and December 1955.

There are 14 companies in the U.S. which now have or will have polyethylene plants in the near future. Some time in 1958 their total capacity will be somewhat over 1.2 billion lb., with around 520 million lb. or more of so-called low-pressure polyethylene included.

There is no longer a feeling that the two types of polyethylene will be highly competitive. The new low-pressure material will probably seek and find other markets than the conventional high-pressure polyethylene. There will be some overlapping and some of the present molding market may be won over by the low-pressure material. But by and large the new material will probably enter new fields. It should be noted that a billion-lb. capacity for polyethylene may be available a year or so before the market is expected to be able to absorb that quantity. A complicating factor

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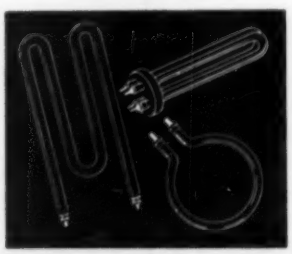

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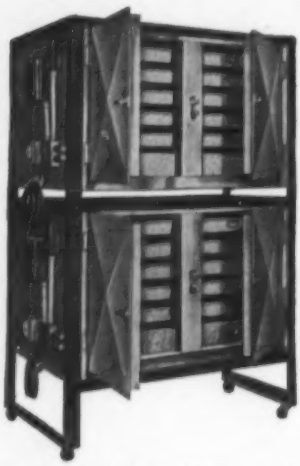

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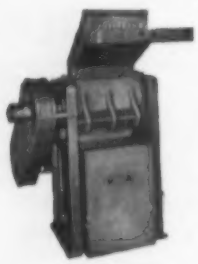

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is likely to arise in the film market, which is by far the biggest of all, since there is some question as to whether or not film made from low-pressure polyethylene is going to be ready for marketing on a big scale by 1960. The flexibility of high-pressure polyethylene film would seem to give it a competitive edge over stiffer low-pressure film until technicians find a way to alter the latter. Of course, there will be a market for low-pressure-type film, but it is still somewhat limited. At least that's the way it looks now. If this situation is still current when that 520 million-lb. low-pressure capacity becomes available, the polyethylene price structure may be subjected to severe alteration, especially in the molding field where the market is not expected to be over 200 million lb., exclusive of material used in bottles, by 1959.

If polyethylene sales fail to keep up with production capacity in the late '50's, it is logical to expect a price decline—perhaps down to a 30 to 35¢ range as measured by today's dollar. Several producers state that they expect a 3¢/lb. differential in price between high- and low-pressure material with high-pressure resin selling at the lower price.

Different formulations

An interesting development is the great number of new formulations now on the market. A film producer, for example, has several choices of clarity, surface, impact strength, or other property he may need to fill the requirements of his customers.

Part of this development has been obtained by increasing the density of the material. Top density is now 0.930 for high-pressure polyethylene, compared to 0.960 for low-pressure. Thus, high-pressure polyethylene is coming closer to duplicating the properties of the low-pressure type. Film made from 0.930-density high-pressure material has improved clarity, crispness, and sparkle that makes it useful in soft goods or liquids packaging where drop strength is not so important. This progress toward higher density of high-pressure resin may obviate the

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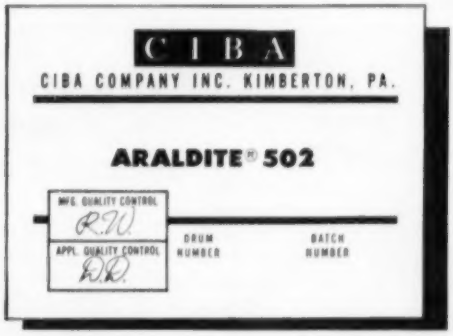

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expected blending of high- and low-pressure polyethylenes to obtain properties in between the two.

Since the development of a polyethylene with stiffness and better heat resistance, there has been less talk of the future for irradiated polyethylene. It would probably always be more costly and at present its future looks like a specialty job for unusually high-temperature applications. Producing a polyethylene polymer by irradiation is something else again but is not likely to be placed on a commercial scale during the next five years.

Perhaps the most important development stemming from low-pressure polyethylene is that the Phillips and Ziegler catalysts have opened up other vast fields. Chemists are unhesitant in listing the new catalytic processes as revolutionary and certain to bring new and improved plastics into being. The possibilities are so great that the plastics industry seems about ready to classify them as polyolefins, with various types of polyethylene listed under that cognomen according to their various properties. Polypropylene in particular is regarded as a promising new member of this family that will bloom in the near future. Styrene produced by this method has high heat resistance. A group of resins in the spectrum between impact styrene and unplasticized vinyl is quite possible. Many new surface-coating resins are envisioned as stemming from these new systems of catalysis. But it is doubtful that such new resins will reach large volume by 1960—five years is too short a time for such developments just as it is too short a time to tell what will happen in polymerization by irradiation. But new and different materials will come into being during this period, and when 1960 rolls around the plastics industry will probably have a good idea of what is to be expected in the next decade from the big new family of polyolefins plastics.

Other materials

The remainder of the plastics in the Table on p. 156 show estimates that are based even more

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on uncertainties than those already discussed. There are not sufficient data on any of them to be able to formulate a good idea of how they may progress in the future.

Acrylics, exclusive of acrylonitrile, are cited for unusually large growth because of steadily declining cost. Methacrylate has superior weathering properties which make it adaptable for outdoor exposure, eligible for competition with reinforced plastics in many applications, and available for various uses in other fields. As surface-coating resins, the acrylics have almost unlimited possibilities and, in fact, are already progressing favorably in many of them.

The epoxies look good for coatings, tooling, encapsulation, and adhesives; even reinforced plastics uses seem scarcely untouched. Furthermore, Carbide and Carbon has just announced the possibility of producing a less costly series of epoxides, one of which may even be used to make a thermosetting resin out of vinyl chloride.

Mylar polyester film is one of the most interesting of the new plastics for future development. The 15 million-lb. estimate for Mylar could be extremely conservative. If ½-mil Mylar ever drops to $1.50 a lb. from its present $2.50 price, it will be definitely competitive with 1-mil cellophane. Such a price drop could create a mild revolution in film circles.

Two applications for Mylar film which could expand to tremendous proportions are bags in which prepared frozen foods can be heated for use and pouches for propellant or active ingredients in aerosols. Another interesting point is that if irradiated foods ever become practical, they can be processed in polyethylene-coated Mylar, which would be unaffected by the processing. Irradiated foods are not just around the corner, but they are almost certainly a distinct future possibility.

Polyurethane could go to anywhere from 75 to 150 milion lb. by 1960. That's a big order, but the market for both flexible and rigid foam is new and could de-

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Deecy Freeze Point	–60°C	–40°C
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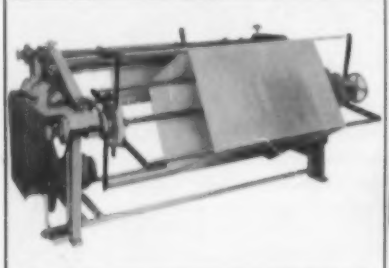

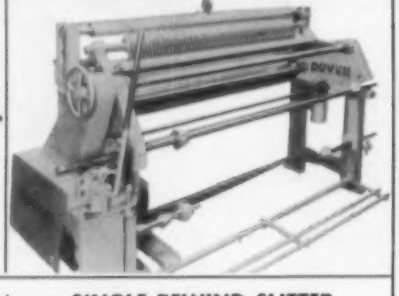

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velop rapidly once it really gets started.

Coumarone-indene and petroleum resins volume has surprised even its producers. The resins are used interchangeably, depending largely upon price, for asphalt floor coverings, rubber reinforcement, and surface coatings. There is some doubt about how competition is going to affect those end products in the next five years, but if asphalt floor-covering volume continues to grow, and opinion in the industry is that it will, so will these indene and petroleum resins.

In a nut-shell

For a quick, thumb-nail description of the outstanding developments to look for in the next five years, MODERN PLASTICS asked Dr. G. F. D'Alelio, well known independent plastics researcher and now head of the Chemistry Dept. at Notre Dame University, for a statement. He mentioned many of the subjects which have been discussed in this article and added these comments:

"It is possible that a number of new plastics families will be introduced . . . there is still a large inventory of unpublished research on the subject. For example, there is a likelihood that someone will have worked out the bugs in the synthesis of monomeric dimethylene quinone and learned how to control its polymerization to a product that is an isomer of polystyrene yet surpasses it in all its properties.

"And how about the new monomer, the 1,4 cyclohexene oxide which gives polymers that have high melting points and can be drawn into fibers?

"But the greatest attention will be given to present families of plastics . . . the industry is excited about the highly crystalline polyethylenes that were introduced as a result of the so-called low-pressure method. Two other medium-pressure systems also produce similar products. Heretofore, these polyethylenes had certain properties not found in the high-pressure polyethylenes, but now the high-pressure method is producing polyethylenes approaching them. Why? It is because they are coming closer all

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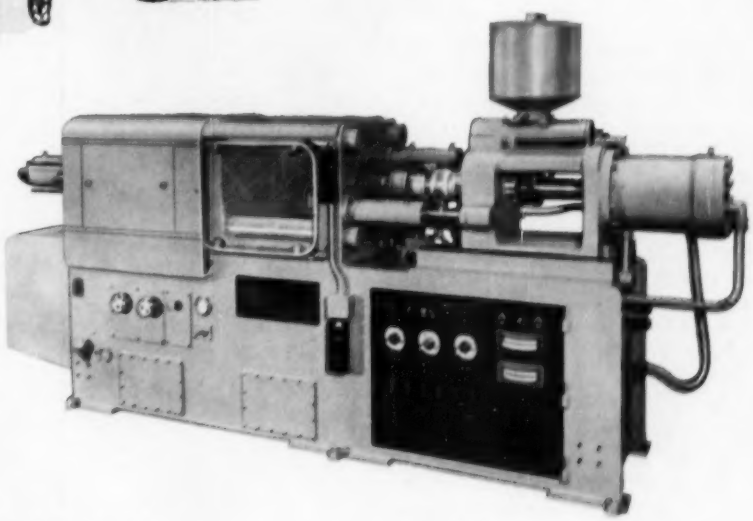

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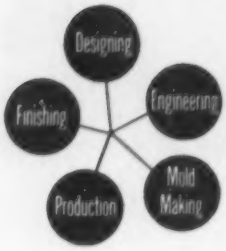

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the time to polymethylene, a product of very specific geometry which has been known for 25 years. If we had really understood the fundamentals of polymethylene, would we have found it necessary to wait this long for the new polyethylenes? . . .

"Even though tomorrow's polymers will be made from the same monomers we know today, they will be sufficiently different from present polymers that they really should be considered new polymers, just as the isotactic polystyrenes (foam) are different from regular polystyrene."

Plastics and defense

One last thought. The plastics industry can't help but be puzzled by the effect which the (around) $35 billion yearly Defense Program will have.

No one seems able to ascertain exactly where plastics fit into that enormous expenditure. On the surface, indications are that plastics participation is small. Perhaps the result is indirect and larger than believed—perhaps the industry will wake up some morning and find that some vital chemical needed for plastics is no longer available because Uncle Sam has channeled it to other uses.

The comparatively small amount of plastics used as such in the Defense Program is surprising since it was World War II that is generally given credit for advancing the plastics industry far beyond its normally expected growth.

The question is: What would happen if that Defense Program stopped or were cut in half? It would seem that plastics would suffer very little from a product viewpoint but might take a wallop from such a huge decline in national purchasing power. There are, of course, exceptions such as methacrylate for airplanes and several of the specialty resins; but by and large the industry seems to be quite independent of that huge defense expenditure—in contrast to the metal industries, for example. In view of past experience, this seems to be a strange situation; however, it is one that is not unpleasant to contemplate.—END

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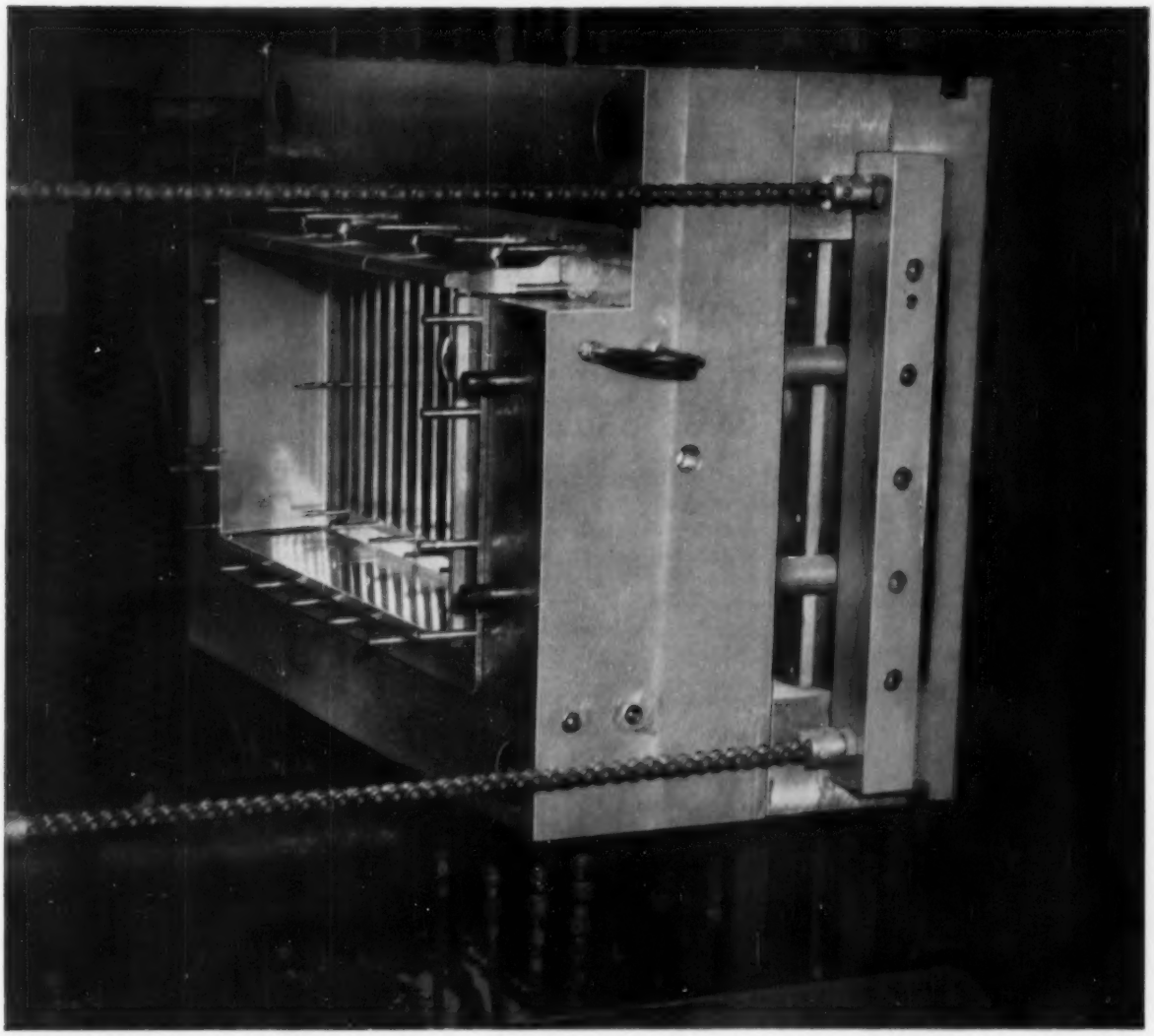

CRUCIBLE CSM 2 mold in press at Pro-phy-lac-tic Brush Co., Florence, Mass. The mold, built by Eagle Tool & Machine Co., Hillside, New Jersey, produces vegetable pans for Hotpoint refrigerators.

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Building

(*From pp. 164-166*)

freely used and easily reorganized—and since many of the elements lend themselves to prefabrication in large units, labor and carrying charges will be reduced.

This is the all-plastics dream house of the future. Just how close it is to actual realization is indicated by the number of proposed structures incorporating these architectural concepts that are today being built on an experimental basis. The results of the Monsanto-M.I.T. survey, for example, are being put to test in the erection of a model House of Tomorrow. The basis for the building design is an 8- by 16-ft. molded module, cantilevered from a 16-ft. square central utility core containing bath, kitchen, laundry, and heating facilities.

From General Electric Co. come reports of a projected Wonder House of 1964 designed by Eliot Noyes. The umbrella-like top of the house will be a plastics sandwich with a foamed phenolic core. Inside partitions would also be made up of sandwich materials—two decorative laminates separated by a light honeycomb core. Floors ducted for air conditioning, interior doors, ceilings, bathtubs, and other components will also be of plastics.

And a "House of Plastics" designed for Artmor Plastics Corp., Cumberland, Md., will soon be going up (see p. 165).

In these experimental houses, of course, plastics in already proved applications, such as tile, flooring, etc., will be put to extensive use.

Projecting even further into the future, architects and designers foresee a number of radical changes which will be based to a large extent on plastics usage.

Plastic dome-like geodesic structures, for example, which are already beginning to play an important role in the design of modern institutional buildings and stadiums (a 750-ft.-diameter translucent reinforced plastics geodesic dome is being considered for the top of the proposed new Brooklyn Dodgers baseball park), may conceivably become

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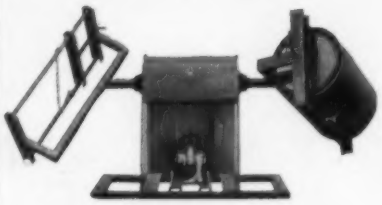

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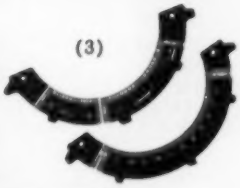

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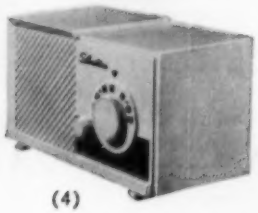

(4)

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Pictured at left: (1) Delphos Springing Horse, (2) RCA Color TV Mask, (3) Altorfer Washer and Dryer Dials, (4) Arvin Radio.

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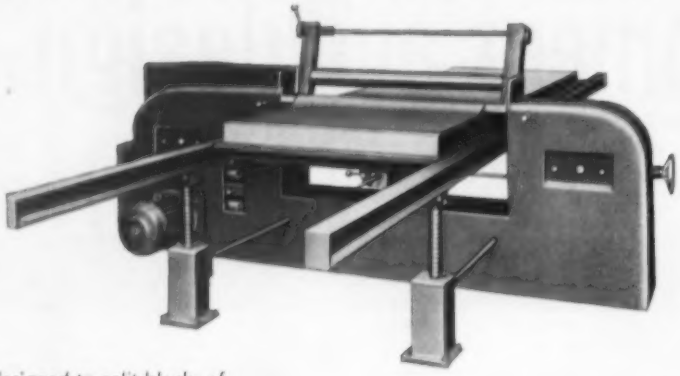

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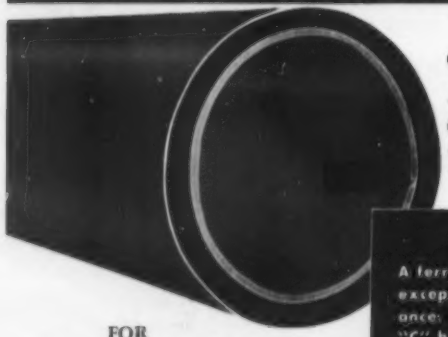

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involved in residential home construction. As designed by R. Buckminster Fuller, such a geodesic dome would be made up of a series of triangular polyester-glass laminate panels attached to a metal or wood framework, to enclose an area large enough to accommodate living quarters and a portion of the surrounding grounds. Climate within the dome would be controlled and the translucent panels would provide a high degree of daylight.

Another innovation in plastic building construction techniques is the inflatable plastic "brick" developed jointly by Prof. Ambrose C. Richardson of the Architecture Department, Univ. of Illinois, and Maj. George W. McCauley of the U. S. Air Force. The basic brick is actually a triangular inflated pillow of polyethylene film. When the pillows are assembled, one brick bears against another so that a self-supporting dome results. Although the structure is not rigid, any pressure exerted on it is absorbed throughout the entire dome.

Developed primarily for military applications—radar shelters, barracks, etc.—the plastics bricks also have potential for commercial use in home construction. For such applications, the bricks would probably measure about 3 ft. on a side and would be 4 in. thick. Automatic valves between the units would allow air to pass from one component to another at 2-lb. pressure to inflate the structure quickly.

The Monsanto-M.I.T. report offers still more radical suggestions for potential uses of plastics, among which are the following:

Plastic "collecting" blankets are envisioned for use of solar energy for water and space heating. The blankets would contain ducts for circulation of the air or liquid which collects the heat and conducts it to the storage unit.

Structures of chemically stabilized earth, using synthetic resins, could answer a real need for economical, quickly constructed homes for desert and vacation housing. Freely curved plans, furniture and openings molded-in with the floor and wall, windows formed by simply embedding a

(*To page* 381)

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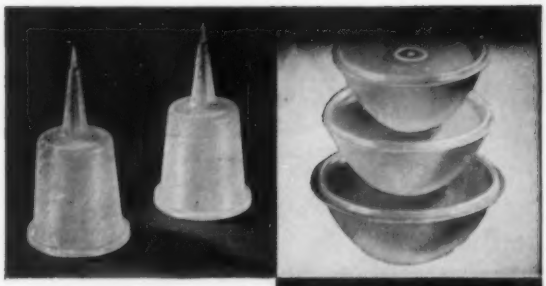

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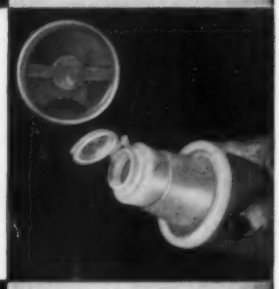

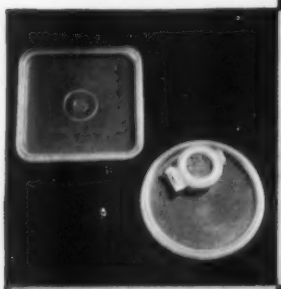

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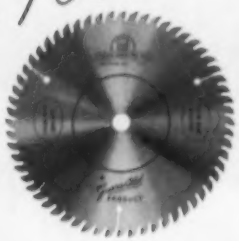

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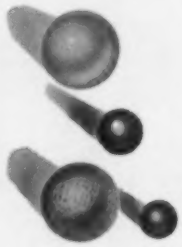

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Small turnings of cylindrical shapes formed from round rods and tubes for all types of applications.

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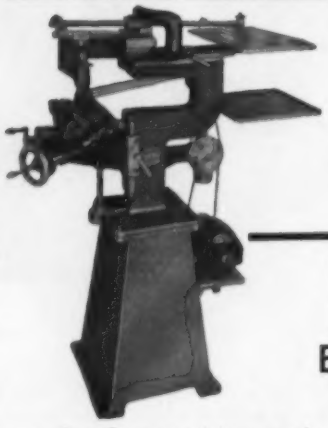

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piece of glass in the earth walls, and tent-like roofs would all be feasible.

Dome-shaped temporary structures are suggested for vacation houses, demountable military and emergency housing, and housing for workers on temporary projects. The domes would be covered with vinyl film and resin-impregnated cardboard panels would be used as structural members.

Transportation

(*From pp.* 166-167)

other train designers are seeping reports of even more startling plastics developments shortly to be announced. One major manufacturer reportedly making use of large one-piece molded reinforced plastics sections has designed a car with roomettes (slightly smaller than conventional size) that can be made available at fares only slightly above current coach rates.

In the not-too-distant future, Mr. Gray foresees such developments as:

1) Reinforced plastics furniture, coach seats, partitions, scuff panels, etc. Investigation is already underway on the possibilities of molded reinforced plastics for structural framing members. (Another train designer sees this trend eventually resulting in molded floors, walls, and ceilings for roomettes and other compartments.)

2) Foamed isocyanates for insulating sides, roofs, and bulkheads, as well as in underframe and belly applications.

3) Increased application for clear plastics, such as the methacrylates, in window glazing, mirrors, light diffusers, etc.

4) Melamine laminates and vinyl-coated fabrics completely obsoleting painted interiors.

5) Reinforced plastics, polyethylene, or vinyl tubing for water, refrigerant, and electrical conduit lines.

6) Vitreous washstands and hoppers replaced by molded reinforced plastics units. (Another designer, stimulated by advances in molding modular bathroom

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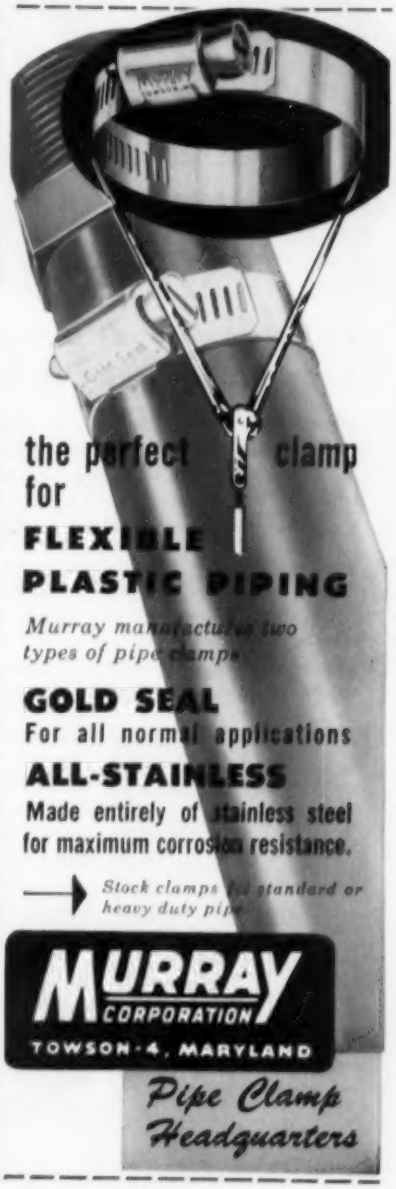
MURRAY RESISTANT

MURRAY CLAMP



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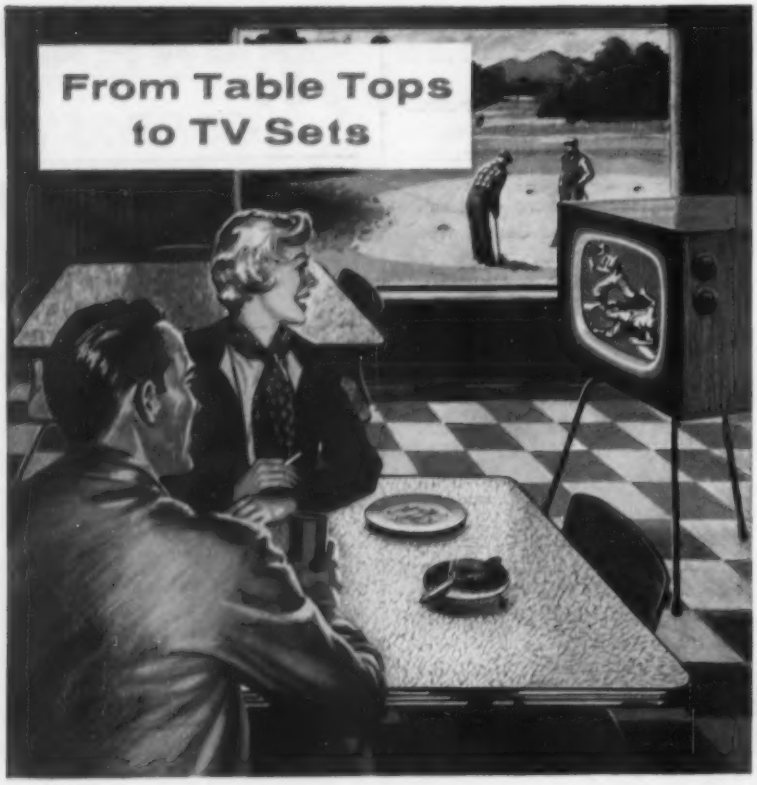

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Complete slitting, sheeting, and die-cutting facilities help reduce costs.

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Reinforced Plastic Moldings • Plastic Impregnated and Coated Materials

units (see p. 166), foresees the possibility of train bathrooms being made up of large molded reinforced plastics walls and ceilings into which washstands, commodes, and other fixtures are molded as integral units.)

7) Reinforced plastics berths and baggage racks in coaches.

8) Isocyanate foam seat cushions and mattresses.

9) Plastics tableware for dining car service and disposable plastics plates, cups, and flatware for lunch counter or snack service.

In a more radical vein, train transportation based on the monorail principle seems destined to provide another market for plastics materials. In Houston, Texas, the first experimental model to be set up in the United States (the monorail has been used in Germany for some time) was recently unveiled by Monorail, Inc. Suspended 30 ft. above the ground from a single rail 30 in. in diameter, the monorail car can zip along carrying 60 passengers at speeds up to 100 m.p.h. The rail is fastened to towers 55 ft. apart. One great advantage of the monorail is that it can be built to travel over most any kind of terrain, above expressways, over city streets, or in open country, and can economically be employed for such specialized purposes as airport-to-downtown city area travel.

In the initial prototype model, several plastics applications were put to good use. Stretching over 75% of the coach (an area of about 3000 sq. ft.) is a shatterproof, waterproof, corrosion-resistant reinforced plastics skin molded by Consolidated General Products, Houston, Texas. Plexiglas acrylic glazing is used for the car's spacious picture windows and within the coach are Eames reinforced plastics chairs and plastics light diffusers.

Similarly, the prospects are bright for the expanded use of plastics appointments in the interiors of airplanes, busses, and ocean liners. Most of these applications will take the same form as described above for the styling of train interiors—foamed plastic cushioning (the New York subway system already has vinyl and polyurethane foam under consid-

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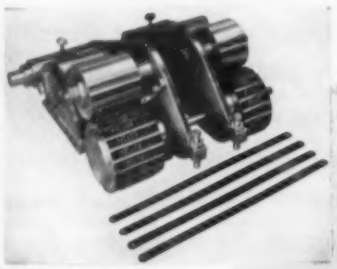

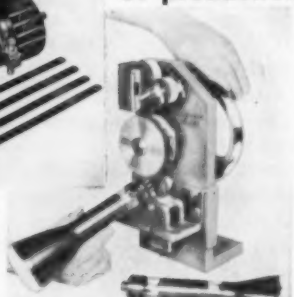

This unit may be attached to a production machine or conveyor with separate drive or with drive from main source. Multiple of printing dies gives high production.

The tube base marker is a hand operated unit for use on plastic bases. Several of these units, strategically placed, can solve many production problems.

Write direct for Engineer's recommendation of proper equipment for your work. Agents in principal areas.

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eration), reinforced plastics furniture and structural members, decorative melamine laminates, vinyl upholstery, etc. In airplane interiors, formed styrene copolymer seat paneling, kick panels, wainscoting, trim, and door coverings figure prominently. Considerable experimentation is also underway in airplanes, busses, and boats in the use of vinyl-to-metal laminates for interior finishes. Note should also be made of the atomic submarine *Nautilus*, designed by Lippincott and Margulies, which utilizes plastics in the bunk design in the form of a resilient reinforced plastic "pan." Designed to accommodate a neoprene-coated mattress, the pan gives comfortably when the occupant is seated and springs back to shape when he stands up.

The design of the exteriors of airplanes, various media of surface transportation, and boats holds promise—as it has in the past—for the laminates and the plastics sandwich materials. In boat design alone, polyester-glass laminates are already moving out of the area of small craft where they have scored such a phenomenal success and into the construction of larger boats. Lunn Laminates, Inc., Huntington Station, N. Y., has launched a 36-ft. LCVP based on a reinforced plastics sandwich with a phenolic-impregnated paper core.

With talk of the future in transportation centering on such possibilities as interplanetary rocket ships, perhaps the best indication of how far plastics can go is a recent report that the designers of the proposed satellite which will circle the earth are considering the use of a plastic laminate in the construction of portions of the rocket shell which will launch the vehicle and the use of a plastic coating (or perhaps even a plastic itself) for the satellite skin.

Automobiles

(*From pp.* 167-169)

increasing—and the chances are good that the second of their two cars will be the more functional station wagon. Since these station wagons will be used primarily for

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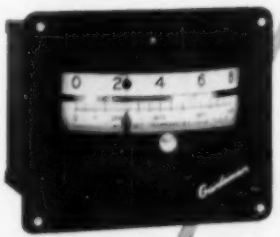

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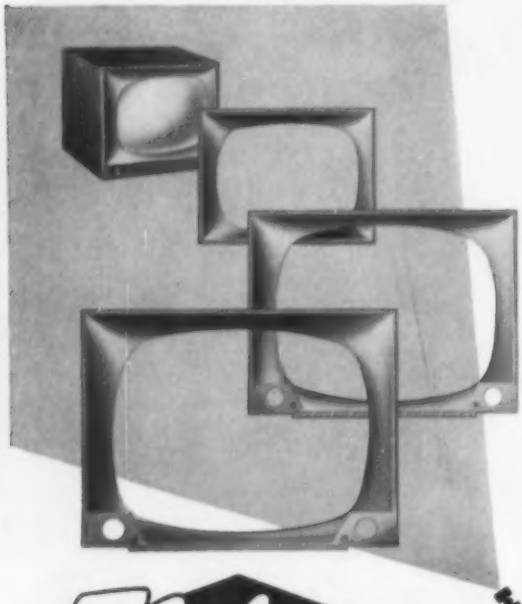

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Lacquers

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The lacquer finish on the polystyrene "mask" or frame (shown above) surrounding the picture tube is vital to good TV viewing. Glare and reflection must be reduced to a minimum and colors must blend attractively with the television cabinet.

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NELCO lacquer formulations are available in all metallic shades for every coating requirement—cellulose acetate, vinyl, acrylic, cellulose acetate butyrate and rubber. Write for complete information on these lacquers and, for our recommendations, just outline your problem to us.

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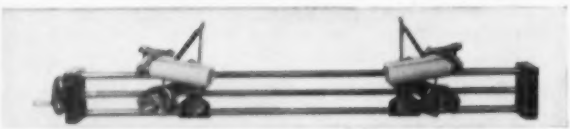

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short hops to the station or shopping center or to cart Junior off to school, today's car stylists are placing major emphasis on an extensive use of plastics sheeting and formed plastics parts that have integral color and texture, that will not scratch, that will withstand considerable abuse, and that are easy to maintain.

In car body design, most future plans are tied up with reinforced plastics. Nearly every automotive engineer interviewed in the course of this survey agreed that the all-plastic car body may become standard equipment on the car of the future—when and if production facilities can match the speed now attained with metal stamping equipment. The mass-production job being done today with matched metal dies on the reinforced plastics components for the Chevrolet Corvette point the way towards this eventuality —and in the not too distant future.

Of more immediate interest from the standpoint of reinforced plastics usage in body components has been the styling trend toward "hard-tops." Ford's Thunderbird already utilizes a removable reinforced plastics top and, reportedly, other manufacturers will soon be taking advantage of the light weight, durability, and weathering characteristics of the material for similar applications. Automotive engineers also are talking about future production lines set up around a basic metal body (which can be turned out year after year on the same tools) and reinforced plastics body components—tops, fenders, etc.—which can be tooled-up at low cost to obtain variations in styling.

Other plans for reinforced plastics in automobile design revolve around the use of premixes (polyester resins in combination with chopped glass or sisal fibers) which can be handled in conventional compression molding equipment. Current usages have been mostly in automotive heating and air conditioning installations, but plans are now underway to adapt the material to motor parts, such as distributor caps.

Acrylic windshields also are seen as part of the design of the "car of tomorrow." The majority

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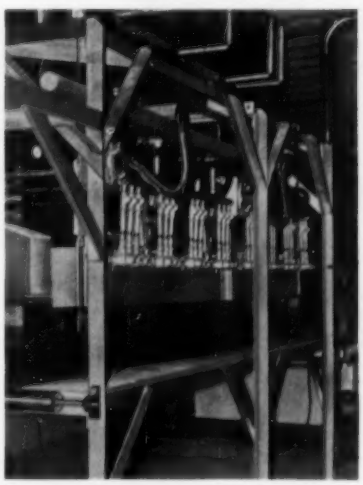

Unit shown here is raised. This prevents injury to material when the web is stopped.

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of "dream cars" which are periodically announced by major automobile manufacturers generally involve bubble-shaped transparent acrylic canopies that fit over the passengers. One manufacturer already has in the works a new model with the back half of the top formed of transparent acrylic to serve as an observation port for rear seat passengers.

Actually, the plastic era in automobile design is still in its early stages. There are still many untouched areas in automobile design that are wide open for plastics applications. Someday, for example, the unwieldly rubber mats which today cover the floor of the trunk area may be replaced by vacuum formed vinyl or polyethylene mats with contoured cavities into which all the equipment that normally goes into a trunk can neatly fit. And why not polyethylene bags attached to the interior of the trunk to provide convenient storage space for the clothes that are taken on long trips? Manufacturers today are also working on plastic bonding agents which would permit rear view mirrors to be attached directly to the windshield.

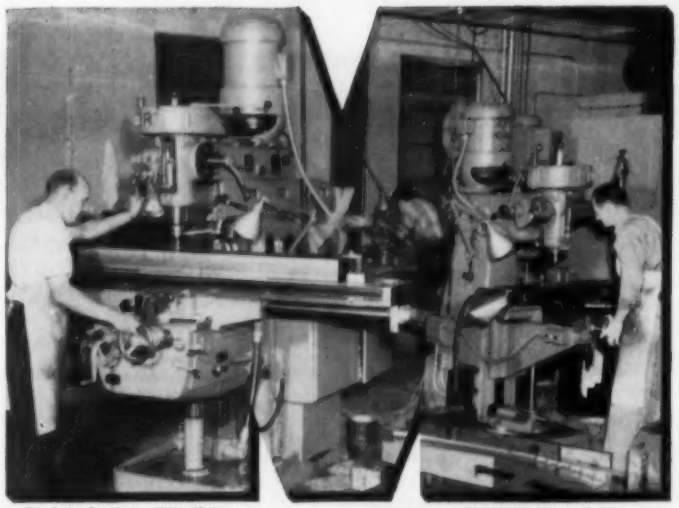
And as new methods of powering future automobiles evolve and new demands are consequently put on automobile styling, plastics can conceivably enter into entirely new, as yet undreamed-of areas of application.

Packaging

(*From pp.* 169-171)

have shown that the advantages of visible merchandising obtained with the plastic unit are sufficiently strong to encourage sales despite the higher price. The molded trays are automatically filled, wrapped, and sealed.

Refinements in the vacuum forming processing technique have similarly opened new fields of packaging applications. One of the most unusual of these has been the packaging of shell-less eggs in formed polyethylene units—a technique developed by Cornell University's Agricultural Experiment Station;



New Gorton Combination Milling Machine

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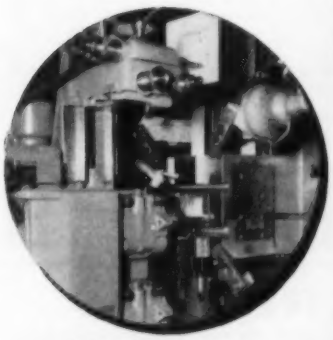
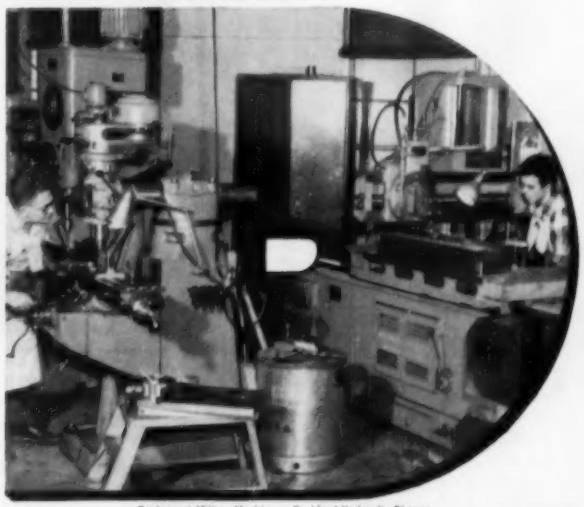
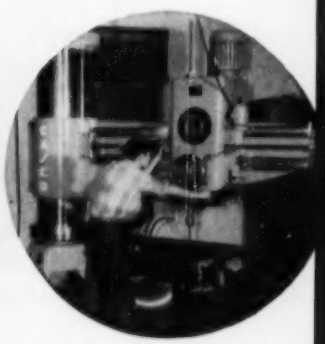


3 Spindle Keller Duplicating Machine



Bridgeport Milling Machine • Rockford Hydraulic Shaper



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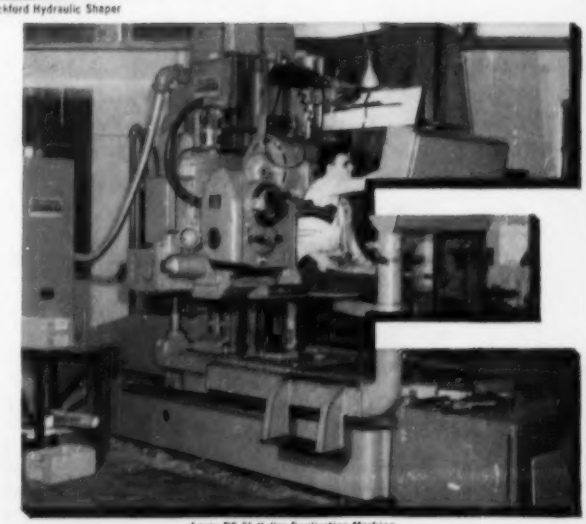

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the rigid PVC foil entirely free of plasticiser and consequently physiologically unobjectionable and officially approved for packaging foodstuffs.

the special type of PVC foil with excellent deepdrawing qualities for vacuum-forming, blow-forming, and plug-forming.

the rigid PVC foil with an exceptional tensile strength, practically moisture-proof, unaffected by temperatures up to 176° F and with good transparency.

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SPEEDS UP PLASTICS COLORING

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Riverdale's new, pre-lubricated formula with improved milling, gives "COLORTROL" ready-to-use colorants, higher color concentration plus superior dispersion . . . imparts new degrees of brilliance, permanence and color uniformity to your product.

The "COLORTROL" system for color matching has proven so faithful that RIVERDALE is the only dry colorant supplier to be authorized to distribute "HOUSE & GARDEN Official Colors" which are stocked in 16 shades.

"COLORTROL" service costs no more than ordinary coloring. RIVERDALE will gladly submit color matches, quotations and information, while Riverdale's color laboratory is always ready for consultation on that special problem. Write to Dept. M.

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as manufactured by Sani-Shell Container Corp., Philadelphia, Pa., the 12-compartment base of the carton is vacuum formed of 20-gage polyethylene. A machine breaks open the eggs and drops them into the individual compartments (measuring 2 by 3 in. and about ¾ in. deep). After carbon dioxide is added to each compartment to retard spoilage, a 3-mil polyethylene film is sealed to the top of the carton to make a spill-proof package.

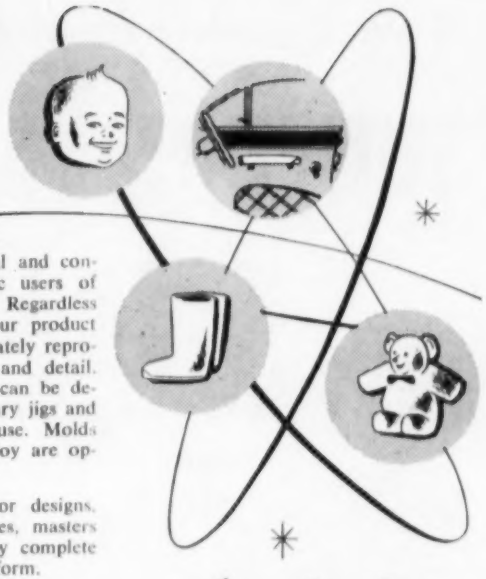
The advantages accruing from the polyethylene pack, according to Sani-Shell, are many. In the first place, it will save a lot of top-quality eggs that are wasted under the present system of grading eggs according to shell size and shape or color. With the new method, the egg content—not the shell—is the important thing. In addition, the housewife can now see the egg she is buying. The polyethylene-packaged eggs can be used in any way a shelled-egg can, and they eliminate the annoying problem of bits of shell showing up in cooked egg dishes. The eggs can be boiled or poached while still in the sealed polyethylene compartments.

Other plastics packaging developments which will undoubtedly find increased usage in the years ahead will include vacuum-formed skin, blister, or contoured packages. The next few years will probably witness the perfection of equipment which will not only feed the rolls of plastic sheet automatically into the former, but will feed the items to be packaged into the container, and seal them in place—all in a smoothly integrated high-speed sequence.

Plastic aerosol containers, involving bodies molded of melamine, polyethylene, or nylon, have already made an appearance on the market and are expected to have a strong influence in future aerosol design. Foamed plastics cushioning for the shipment of delicate products is also under top consideration by package designers.

Along with improved materials, improved and more highly automated packaging machinery, and a growing awareness of what properly selected plastics can do

Electroformed molds for plastisols



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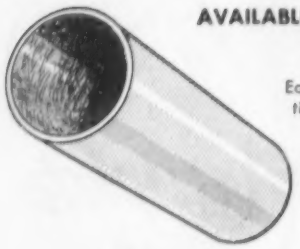
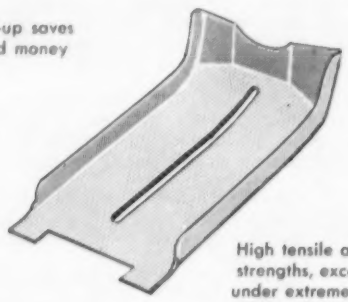


Easy lay-up saves time and money



Keeps rejects to a minimum because resin impregnation is mechanically controlled for uniformity.

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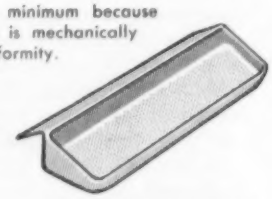

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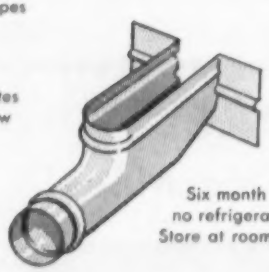

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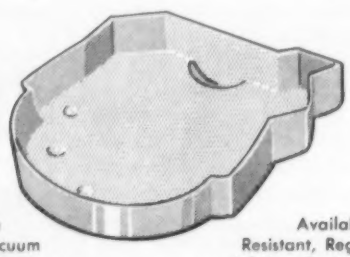

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for the packaging of a product, the next decade will surely see plastics as packaging materials rise to heights never before even dreamed of.

Communications

(*From pp.* 171-172)

laminate Pla-Cir printed circuit. Butyrate was selected for the application because of its light weight, its attractive appearance, and the fact that it permits the loop-type antenna to be incorporated within the case without distorting its signal.

Smaller-size units are as evident in TV sets as in radio. This is the way manufacturers foresee future markets for TV: as prices are beaten down by increased production, families will demand multiple home sets—one, a more costly large-screen color receiver; the other, a small-screen portable black-and-white set that can be moved from room to room. Looking even further into the future, electronics engineers predict that portable TV sets will eventually supplant present console-type models—in much the same way as the portable radio has largely supplanted the console radio.

In both large-screen color receivers and portable black-and-white sets, plastics have an important role to play. A major application in color television (retail sales of color sets may account for as much as $175 million in 1956) will probably be molded polyethylene shields, used to insulate the newest of color television receivers which operate at 25,000 volts.

The portable black-and-white TV sets are expected to recapture for plastics a good share of the cabinet market. One manufacturer predicts that, within five years, over 50% of the portable TV cabinets on the market will be injection molded of high-impact styrene alloys. On the horizon is an even newer development that might increase the percentage considerably. Electronic engineers anticipate the development of thin screens ("picture-frame" television) that will ultimately provide the same ver-

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Originators of Dry Process Plastics Extrusion

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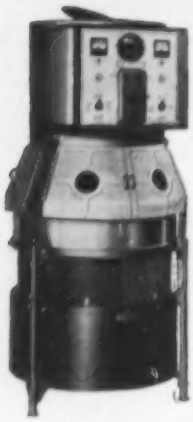

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satility available today in portable radios. This type of screen, using small batteries to power its transistorized circuits, will fold into a cabinet and can be used on picnics, at the beach, in the garden, and while traveling. Plastics are expected to be chosen for these cabinets for much the same reasons of ruggedness, appearance, ease of maintenance, and light weight that have determined their selection in the field of portable radios.

In phonographs, one manufacturer predicts that within five years the majority of platform tops for table-model phonographs will be vacuum formed of decorated styrene sheet (printed thin-gage oriented styrene sheet laminated to heavy-gage opaque high-impact styrene) with contoured cavities to accommodate dials, turntable, and tone arm.

One electronics engineer interviewed in the course of this survey predicted a particularly bright future for plastics tape (especially Mylar polyester film) in audio tape recorders and the newer video tape recorders which can be used to record pictures on tape and then "play them back" through the television screen.

Furniture

(*From pp.* 172-174)

either injection molded or vacuum formed from thermoplastic sheet stock and then given hardness and greater rigidity by subjecting them to a source of irradiation. The advantages of this technique would be two-fold. First, it would cut down on the expense of costly tooling for metal stampings which, in turn, require expensive finishing operations. Secondly, since these units would be essentially fastening devices and structural components, they would help to get around the problem of gluing which still often proves to be a production bottleneck.

4) Sprayed-on plastic upholstery. Although this application may still be some time away, Mr. Wilson believes it is almost inevitable. By spraying a suitable type of plastic upholstery directly

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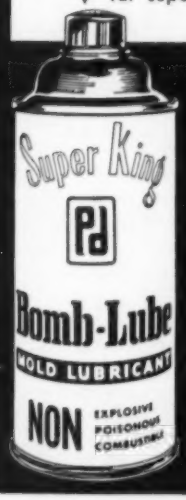

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1"	√	√	√	√	√	√	
1 1/8"	√	√					
1 3/16"	√			√			
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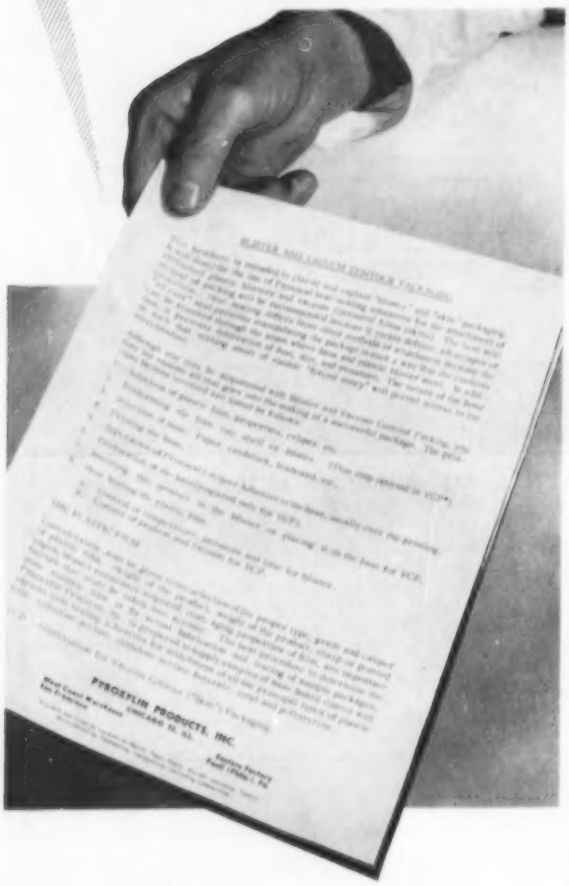
The facts about
BLISTER
and
VACUUM CONTOUR
PACKAGING



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over a padded steel or reinforced plastics frame, problems now associated with the fastening of upholstery fabrics to contoured shapes would be eliminated. Since the upholstery surface would be bonded to the padding throughout the entire piece, such problems as tearing or the separation of the upholstery from the chair or sofa would be minimized. In addition, production costs would be relatively low.

5) Rigidized, resilient sheet stock as padding between basic frame and upholstery. At present, cotton, rubberized hair, and special types of paper cushioning are used for this purpose. A resilient yet rigid plastic material (possibly extruded) could easily be tailored over the inner frame, providing a protective backing for the outer upholstery and giving the entire piece a more pleasant feel and better look.

6) Decorative transparent or translucent sheets for buffets and other case goods. These sheets, which might be in the form of laminates with a decorative filler or might be a single sheet formed with integral texture or pattern, could be used to replace the glass components which today present a problem of breakage in transit. Some work has already been done along this line with screens, room dividers, etc.

7) Metallized Mylar polyester film as a trim material. Such trim is already gaining rapid acceptance in the automotive field as well as for such major appliances as refrigerators. Its adoption as a decorative adjunct to various furniture pieces, in place of the more costly and difficult to install metal extrusions and other types of trim, opens up many new possibilities.

Appliances

(*From pp.* 175-177)

picture. More recently, Apex Home Appliances, Div. Apex Electrical Mfg. Co., introduced a family-size washer with table-top cover, splash guard, and square-shaped washer tub all molded of reinforced plastics.

A number of companies are

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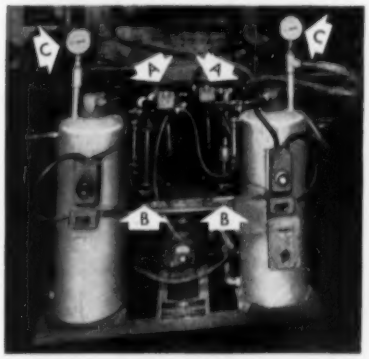

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It is fully automatic in operation, requiring practically no attention. Model shown has a drying capacity of 100 to 200 lbs. per hour, depending upon the material.

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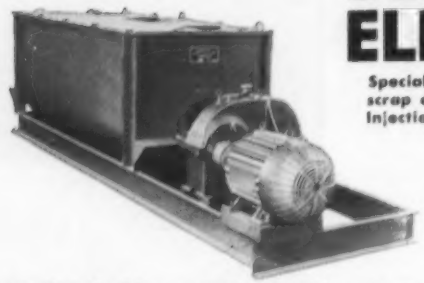

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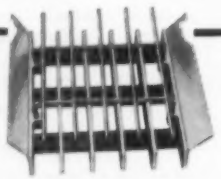

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also considering the idea of molding smaller components of polyester-glass molding compounds (premix). Support brackets for refrigerators are one possibility, door latch mechanisms for various types of appliances are another.

Just how far plastics materials will go in other future appliances is a question that is going to have to await the full development of these appliances. In the foreseeable future are revolutionary new applications that will conceivably change the entire concept of homemaking—automatic equipment to convey, sort, clean, iron, and fold laundry; dishwashers that clean by supersonics; chemical disposal units; electronic stoves that will eliminate the need for pots or pans; and electronic warming drawers that will keep cooked foods hot. And there is going to be another market for plastics in each one.

Housewares

(*From pp.* 177-178)

rather than with other plastics, that a good deal of the future for plastics housewares lies. Stimulated by today's emphasis on self-service at the retail level and by the consequent desire on the part of retailers for colorful products that increase impulse buying, the number of large polyethylene moldings that are being put on the housewares market has increased at such a fantastic rate that today they account for about 25% of the total plastics poundage consumed by the market. Some market analysts foresee the time when polyethylene eventually will have completely supplanted metal in this area. Designers are already working on plans for new large moldings incorporating molded-in features which would have been economically unfeasible with other materials, e.g. a baby bath with arm rest for mother and a soap and cloth tray molded-in.

No one has yet figured where low-pressure polyethylene will fit into this housewares picture—but it certainly is going to be a vital factor. The feeling is that

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the new material will provide the same sort of over-all impetus to the housewares market that the availability of regular polyethylene did, particularly where its high heat resistance, strength, and rigidity will permit it for products now limited to metal.

Molded melamine dishware, which now accounts for some 18 to 20 million lb. of material a year, also holds considerable promise for the future. As new decorating techniques and new styling ideas get off the ground, poundage is expected to zoom.

Perhaps the greatest growth potential for plastics in the housewares field, however, is in disposable drinking cups and dishes. Recently, Crown Plastic Cup Co., an affiliate of Crown Machine and Tool Co., Ft. Worth, Tex., began production of injection molded thin-wall cups for use in automatic coffee vending machines. (Hot liquids served in the cups should be at drinking temperatures, not to exceed 160° F.) So enthusiastic was the reception to the cups, that Crown is now manufacturing a 9-oz. retail pack for grocery stores, variety stores, and other outlets where picnic goods are sold. The packages of six each are being marketed at about 20¢ retail—just a few pennies more than standard paper picnic cups and still low enough in cost so that they can be thrown away after a single use. Crown is currently turning out the cups at the rate of 900,000 a month.

Some economists foresee the Crown cups as the forerunners of a complete line of disposable tableware, including dishes and utensils, that would be ideal for picnics, beach use, as spares in the home, for quick lunch counters, and for snack bars.

Advances in sheet-forming techniques are also pointing in the same direction. As research progresses in continuous automatic extrusion-forming hookups, it is expected that the price of formed housewares will drop drastically. And with predecorated styrene sheet (in wood grain, marble, or other patterns) recently made available to sheet formers, completely new merchandising opportunities have opened up.—END

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The following three materials are vinyl chloride – vinyl acetate suspension copolymers.

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SOLVIC 100 series (122, 124, 136)
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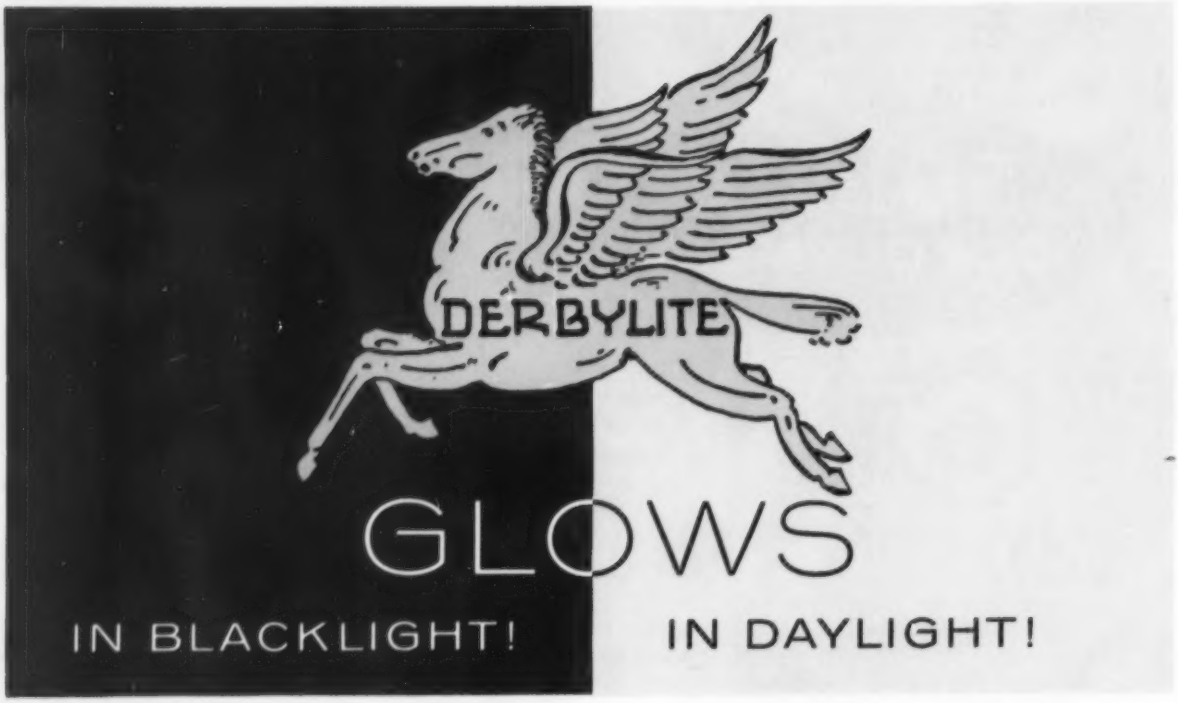

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Plastics engineering

(*From pp.* 179-182)

where cooling time determines the over-all cycle. Since the rate of cooling is proportional to the temperature difference between the plastic and the mold surface, the effect of a given degree of sub-cooling will be greatest with those plastics molded at relative low melt temperatures, e.g., polyethylene. The portable refrigeration units now available will make mold refrigeration practical even in small shops.

Is write-off fast enough?

At present there are no definite rules by the Federal Government regarding rates of write-off of plastics processing equipment. Each field agent must decide if the write-off rates claimed are realistic. The S.P.I.'s book of accounting procedures recommends a minimum period of 10 years for depreciating molding and extrusion machines, 15 years for calenders, mills, and mixers, only 4 years for electronic preheating equipment. With machine productivity increasing as rapidly as it is, and labor costing what it does —and it is sure to cost more in the future—it is questionable whether a molder can afford to keep a man on a machine that turns out half or less of the product of its newer brothers. Certainly a shorter write-off period would encourage replacement of obsolescent equipment and more rapid spread of better methods.

Extrusion

A trend already clear in the design of extruders is the application of the principle of adiabatic operation; that is, operation in which all of the heat needed to melt the polymer and raise it to the die temperature is obtained through the shearing work of the screw. While it will probably not be possible to realize more than 70% efficiency, many of the present screw extruders are operating at much lower values.

If the heat is not worked into the material by the screw, it must be transferred into it through the metal surfaces of barrel and/or screw. For high production rates, since heat-transfer coefficients of polymer granules and melts are low, steep temperature gradients and high wall temperatures with the accompanying risk of polymer degradation become necessary. On the other hand, heating by working requires that the extruder screw have flights that are shallow in comparison to the screw radius, so the work is distributed nearly evenly throughout the advancing mass. Hot spots are avoided, energy losses are small, operation is economical.

Near-adiabatic operation requires long screws and barrels and relatively large motors—something on the order of 1 hp. must be available *at the screw* for each 10 lb./hr. of output. Obviously the screw cannot be made indefinitely long: the longer the screw, the greater the torque at its rear end where the threads must be relatively deep to accommodate the low-density granular feed. Since the allowable torque

(*To page* 407)

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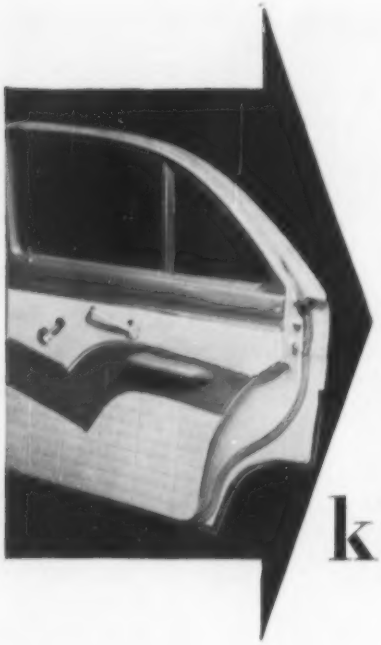

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and caused important changes in coating, laminating, and other plastics operations

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But the unusual advantages of Lantuck are being recognized not only in coating, but also in laminating and "plumping" types of applications. If you're looking for ways to reduce production costs *and* improve product performance, look to Lantuck. For details, write Lantuck Dept. M6.

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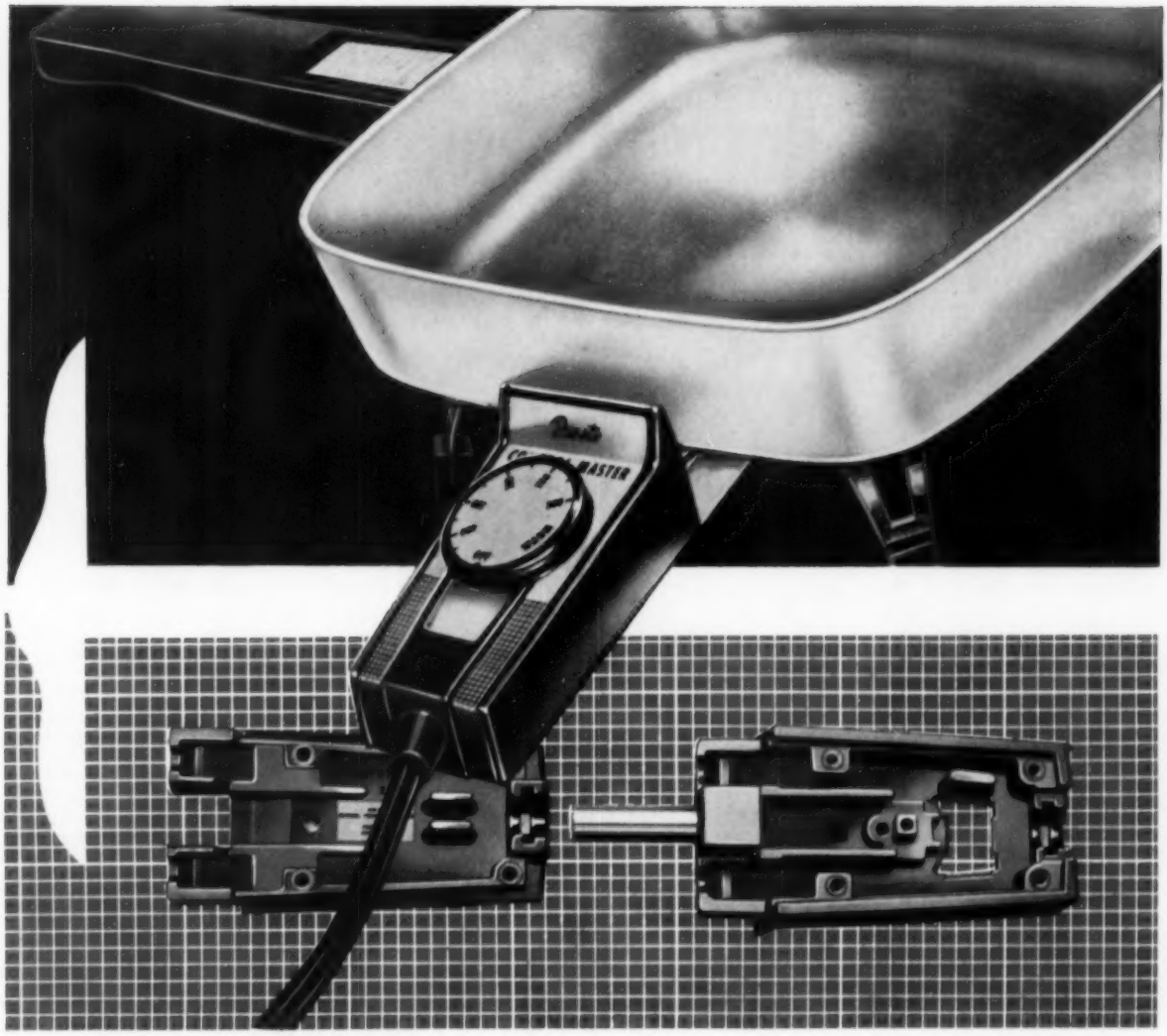

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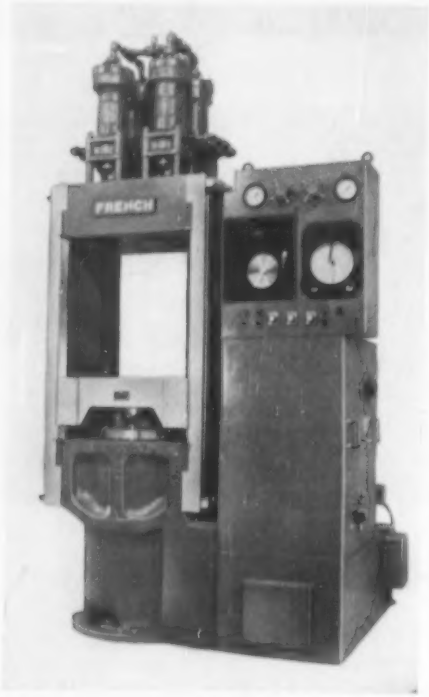

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is proportional to the fourth power of the screw-root radius in a cored screw, the screw, paradoxically, is weakest where it needs to be strongest. This suggests that manufacturers may soon find practical ways of mounting the drive at the delivery end of the screw, where its root diameter is greatest and would be able to carry much larger torques than with the conventional arrangement. Effective seals against leakage of the melt around the rotating shaft have been devised and tested, but the drive, so mounted, might be hopelessly in the way of sheeting dies and take-off equipment.

Adiabatic extrusion offers another important advantage. The nearer fully-adiabatic operation can be approached, the more rapidly does expected output increase with machine size. If the screw is so designed that very little of the energy is worked in, a 4-in. machine can be expected to put out about 4 times the output of a 2-in. machine; if the operation were perfectly adiabatic, the 4-incher would be able to deliver eight times as much. At least three makers of extruders are already marketing machines designed to approach fully-adiabatic operation. These screws have length-to-diameter ratios of about 20:1, far longer than any seen even a few years ago.

Extrusion versus calendering

The successful introduction of roll bending (see MODERN PLASTICS, *33*, 138, April, 1956) adds a new element of control and versatility to the calendering operation. But calenders themselves are very expensive and require a lot of auxiliary equipment—mixers, mills, and high-pressure hot water systems.

In contrast, there have recently been significant advances in the design of sheeting dies, and, as we have seen, in extruder productivity. Developments are underway in both the U. S. and Britain to improve the mixing characteristics of single-screw extruders; prospects are very encouraging. Except perhaps for Ole Debbil Carbon Black, it should be possible within the next few years to do perfect blending in extruders

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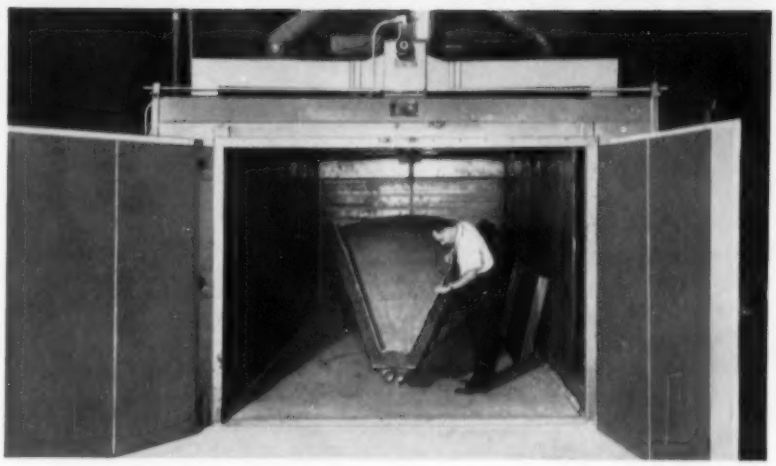

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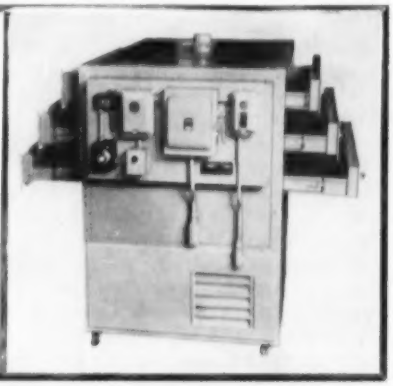

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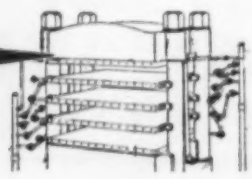

of mixtures of base resin and pigmented master batches. Labor costs in making film and sheeting should be greatly reduced if this development bears fruit.

Compression and transfer

Automation and preheating are the biggest trends in compression and transfer molding today, and they have been developing for years. These developments and their immediate future prospects were told at length by E. F. Borro in MODERN PLASTICS, *33*, 145, May, 1956. Here, as in injection molding, fully automatic operation is at present restricted to the production of small parts but it will be extended to larger parts soon. Preheating, which has been used for years in most plants, is being pushed even harder with the continued improvement in high-frequency preheaters. Because it is practical to preheat many thermosets to a point close to the curing temperature, a substantial cut in the cycle can be realized by preheating. This cut is made more impressive by the fact that today's compounds cure more rapidly than ever, so that the curing time may be, for small parts, 30 sec. or less. Without preheating, the cycle would be four or five times as long. Even shorter cycles can conceivably be expected in the future.

Metallizing of plastics

Vacuum-metallizing of plastics at present involves a great deal of hand labor in preparing and protecting the surfaces and in loading and unloading the racks for the vacuum chamber. The actual metallizing takes only seconds, while pumping down the vacuum chamber requires about ten minutes. Even as it is, the process is by far the least expensive way of putting a brilliant, continuous metal coating on a plastic (or other) surface. Almost any metal can be deposited in this way. In the future, vacuum-metallized plastics, which have already been used for inside trim in autos, may take over some of the tougher service spots. One vacuum-metallizer even visualizes automobile bumpers made of vacuum-metallized glass-reinforced plastics!—END

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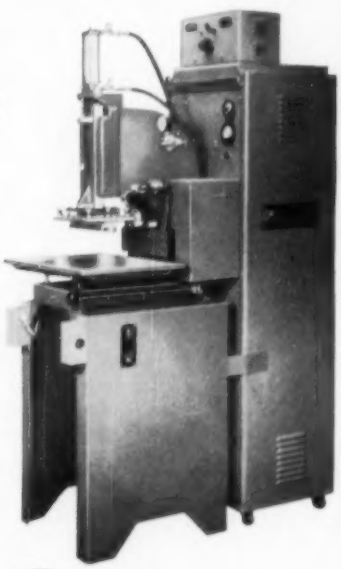

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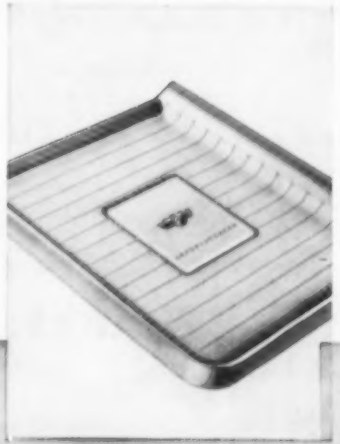

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Portable coin sorter

(*From pp.* 183-185)

also fasten this assembly to the formed sheet housing. The safety plate, which prevents coins from jumping out of the selector slide, is mounted at the top by means of two self-tapping screws, so that should coins become jammed before passing into the sorting slide, they may be instantly freed simply by lifting the bottom of the safety plate slightly forward. Attachment of the carrying handle to the top of the housing, also accomplished with self-tapping screws, completes the assembly of the coin sorter.

Dependable performance and freedom from maintenance have made the new unit increasingly popular. Regardless of tough and prolonged service, the Speed Sorter will retain its original handsome appearance because the durable plastic housing will not dent or crack, has no surface finish to wear off, and can be kept clean simply by occasionally wiping the plastic surface with a damp cloth.

At the present time, Carroll is stockpiling reserve quantities of the injection molded parts, then turning out the case components in sufficient volume to keep pace with sales requirements. Working in this manner, the entire operation can be kept under orderly production control.

Should future demand reach the point where it is no longer practicable to turn out a sufficient supply of vacuum formed housings, the company may consider injection molding of these parts. Meanwhile, the present combination of molded and vacuum formed parts, which might well be studied by many companies having a similar sales and production arrangement, provides the Carroll organization with an extremely desirable production flexibility.

Credits: High-impact styrene sheet stock for vacuum forming supplied by Auburn Button Works, Inc., Auburn, N. Y.; injection molded parts, Nu-Dell Plastics Corp., Chicago, Ill.; butyrate, Eastman Chemical Products, Inc.; stock handle, Weiland Metal Products Co., Chicago, Ill.

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	MARVINOL VR-12	MARVINOL VR-20	MARVINOL VR-21
Description	General Purpose extruding and calendering.	Film Calendering.	Cold, dry premix for calendering film and sheeting.
Special Features	Highest molecular weight. Low deformation at highest temperatures. Very fast mill or Banbury mixing. Good for blown extruded film. High speed extrusion.	Medium molecular weight. Recommended primarily for calendered film. Behaves well in hot or cold premixes. High bulk density for large Banbury charges.	High molecular weight, cold, dry premixing resin. Leaves mixers clean, minimizing color changeover problem. Recommended primarily for calendering film, sheeting and coated fabrics.
Resin Properties			
Specific Viscosity	0.52	0.38	0.44
Average Apparent Density, lbs/cu. ft.	22	32	21
Average Particle Size, microns	6	32	11
Acetone Solubility	20	37	31
Specific Gravity	1.40	1.40	1.40
Compound Properties* (100 parts resin, 50 parts DOP)			
Brittle Point °C.	−24	−20	−22
Shore "A" Hardness	82	78	80
Tensile Strength, psi	3000	2700	3000
Ultimate Elongation, %	340	330	330
100% Modulus, psi	1750	1650	1750
Tear Strength, lbs/in.	480	430	450

MARVINOL DATA REQUEST FORM

NAUGATUCK CHEMICAL,
Div. United States Rubber Company, Naugatuck, Conn.

Please send Technical Data on Marvinol resins checked at right.

Name.....Title.....
Company.....
Address.....
City.....Zone.....State.....

☐ Do (☐ Do not) have your Technical Representative call.

☐ VR-10
☐ VR-12
☐ VR-20
☐ VR-21
☐ VR-22
☐ VR-24
☐ VR-30
☐ VR-50

*Compound properties shown above are intended primarily for comparison with other Naugatuck resins, all of which are tested on the same equipment. Comparison with similar figures on resins of other manufacturers can be very misleading, since values obtained with different testing equipment may vary widely, even though the same methods are used.

HERE'S the newly enlarged family of MARVINOL® vinyls, the industry's most complete line of straight polyvinyl chloride resins! Whatever your processing equipment...whatever your end product, there's a MARVINOL resin ideally suited to your needs!

May we send you literature and technical data on any of these outstanding PVC resins? There's a handy request form provided below for your convenience.

Improved

MARVINOL VR-10 has approximately the same resin and compound properties indicated for MARVINOL-12 but has been *improved* in its viscosity and oil-absorption characteristics to make it especially suitable for *plastisol* use. It is recommended for blending with stir-in resins (such as MARVINOL VR-50) to impart improved heat stability and tensiles, to reduce tack and to lower cost.

MARVINOL VR-22	New MARVINOL VR-24	New MARVINOL VR-30	New MARVINOL VR-50
Electrical Grade. Hot, dry blend for extrusion.	Easy processing and calendering.	Cold, dry premix for coated fabrics, film, sheeting and calendering.	Paste Dispersions.
High molecular weight with high bulk density for large Banbury charges. Excellent hot, dry blending properties for extruder feed; reduces mixing cycles. Approved by Underwriters' Laboratories, Inc. for electrical applications.	Low molecular weight with high bulk density, designed for low temperature calendering. Can be hot dry-blended. Can be used in semi-rigid compounds.	Medium molecular weight, low bulk density. Minimizes mixer clean-out problems. Mills and Banburys rapidly. Particularly good for most phases of calendering: film, inflatables, sheeting and coated fabrics. May be heat sealed. Excellent for injection molding.	Stirs into plasticizers readily to form pastes of good shelf life and excellent viscosity characteristics, for cloth-coating, dipping, slush molding, film casting, spraying and rotational molding. Makes excellent organosols.
0.44	0.30	0.38	0.50-0.52
27	33	21	15-19
22	25	15	—
25	51	46	—
1.40	1.40	1.40	1.40
			Physical Properties 6 mil Film, 380° F. (100 parts VR-50, 66.6 parts DOP)
−22	−16	−20	
80	77	78	
3000	2200	2700	
330	250	320	Tensile, psi 2700
1750	1500	1650	Elongation, % 280
450	370	410	100% Modulus, psi 1300

United States Rubber

Naugatuck Chemical Division

Naugatuck, Connecticut

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☐ **POLYESTERS AND THEIR APPLICATIONS** *by Bjorksten, Tovey, Harker and Henning.* The first comprehensive survey of the polyester field from raw materials to fabricated products. Text plus over 3,500 references cover almost every phase of the production and use of polyesters including saturated polyesters used in the production of fibers, films, elastomers and foamed plastics.
1956, $16.00

☐ **FIBERGLAS REINFORCED PLASTICS** *by Ralph H. Sonneborn.* The first complete treatment ever published on reinforced plastics. Covers in full detail the resins and glass reinforcements used, molding techniques, inspection and testing, properties and design considerations. Provides all those concerned with reinforced plastics with valuable information never before available in one compact volume.
1954, $4.50

☐ **PLASTICS TOOLING** *by M. R. Riley.* Summarizes all the information, both published and unpublished, concerning the use of plastics in jigs and fixtures, metal forming dies, plastics-forming molds, die models and prototypes. Describes tools now made of plastics, resins used, how they are made, how long they last, what they cost, etc.
1955, $2.50

☐ **PLASTICS ENGINEERING HANDBOOK of The Society of the Plastics Industry, Inc.** The most complete, best arranged information ever published on the design, materials, processes, equipment, finishing, assembly, testing and standards of plastics and plastic products. Entirely rewritten, this new edition of the famous SPI Handbook is almost twice its former size. Suppliers of raw materials will find a complete set of accepted standards and specifications. Designers and engineers will find new testing methods fully described. Users of plastics will welcome the standards for testing, rating, certifying and labeling plastic commodities.
1954, $15.00

☐ **PLASTICS FOR CORROSION-RESISTANT APPLICATIONS** *by R. B. Seymour and H. H. Kleiner.* Shows engineers how to select the right plastic for construction in corrosive atmospheres; the use of plastics as protective coatings, organic linings, chemical resistant mortar cements, casting resins, plastic foams, impregnants, industrial adhesives and reinforced materials. Plastics available for a specific application are compared in tabular form for quick, easy selection of the most suitable material.
1955, $7.50

☐ **CHEMICAL MARKET RESEARCH IN PRACTICE** *Edited by R. S. Chaddock.* 22 experts cover every phase of the subject from the evolution of chemical market research, its relationship to basic research, products and markets to actual case studies. Emphasizes organization, personnel, market surveys, literature, field work and reports, and includes lists of information sources.
1956, $3.00

☐ **PATENT LAW IN THE RESEARCH LABORATORY** *by J. K. Wise.* Shows clearly the importance of patent law in research activities. Explains how patent rights are acquired, preserved and sometimes lost through neglect or improper action. Outlines the rights that patents confer, assignment and licensing, required laboratory records, and many other important topics.
1955, $2.95

☐ **NEW HORIZONS IN COLOR** *by Faber Birren.* Everything you want to know about the influence of color on health, safety, efficiency, lighting, fatigue and psychological reaction. Written by the country's top color expert, the book draws from wide experience and case histories and examines all known systems of color and color harmony. Over 150 illustrations, 2 pages of color chips.
1955, $10.00

☐ **PACKAGING ENGINEERING** *by L. F. Rarail.* First to describe all packaging materials, their best uses, and methods employed by packaging engineers to obtain the most efficient results at lowest possible cost. Covers types of containers, machinery, package design, protection against deterioration, labeling, testing, and all other engineering and design aspects.
1954, $9.50

☐ **ORGANIC PROTECTIVE COATINGS** *edited by W. von Fischer.* Solutions to the problems of formulation, specification and application. Covers fundamental theory and practice of paint as an engineering material plus anti-corrosive and luminescent pigments, aminoplast resins, hot spray lacquers, emulsion and latex paints, protection of metal surfaces with synthetic resin coatings, new applications of organic coatings to electrical insulation, and the use of silicone resins in heat-resistant paints.
1953, $7.50

☐ **INDUCTION AND DIELECTRIC HEATING** *by J. W. Cable.* A carefully organized, up-to-date treatment of the uses and applications of high frequency heating. Covers fundamental theory, equipment, coil and electrode design, work handling methods and important applications.
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☐ **HANDBOOK OF BARREL FINISHING** *by H. F. Ingels.* Covers every phase of barrel finishing in step-by-step sequence. More than 150 specification sheets provide all information for finishing metal and plastic parts.
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Styrene cases

(*From pp. 186-187*)

tainers, which usually run around 5/16 inch. The thinner walls enable the manufacturer to pack 57 high-type plates into the battery, yielding a total of 3486 sq. in. of plate area and 38% more exposed plate material than industry requirements. The increased internal capacity of the battery also permits use of 3½ times more fluid above the plates than in ordinary batteries. This more than triples the battery's evaporation protection and renders it 33% more resistant to overcharge.

Shipping savings

The reduced weight of the finished battery, made possible by the molded plastic case, is reflected in sizable shipping savings on the thousands of batteries shipped each year. The unit weight saving, as compared to a battery having a hard rubber case, is approximately 4½ pounds. Furthermore, tests have shown that the durable styrene cases are less subject to damage in shipment and handling.

After the internal components of this battery have been inserted in the case, the top is permanently cemented in place with a filled-solvent type of adhesive. To obtain the required seal between case and cover, rectangular molded styrene "gutters" are first placed in position on an internal ledge molded at the top of each cell compartment. These gutters prevent the adhesive from draining down into the case. After the solvent has been introduced into the gutters, the cover is set in place and clamped until the joint has hardened. This sealed-top feature of the plastic case has the advantage of being tamperproof, since the cells cannot be removed.

Among other features of these particular plastic battery cases are two small snap-out access panels, molded of modified styrene in a matching color, which give a smooth, finished appearance to the cover. With these panels removed, coded information on the production date, lot numbers, etc., can be stamped directly on the metal connectors beneath. Also, when the battery

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Wilner has two wood flour plants — completely separated — completely redesigned and rebuilt in 1951 — each plant safety engineered from the ground up.

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Typical Analysis 60 Mesh Wood Flour

Thru	On	%
	60	0
	80	2
140		76.8

Uses of Wood Flour

Wood flour is a *filler and extender*, adding strength, bulk, lightness and impact resistance to other more costly materials, such as plastics, linoleum, roofing felt, molded rubber products, wall board and vinyl floor coverings. It is an ideal *absorbent* for explosives, adhesives, rug and fur cleaners, stock feeds, and fertilizers (with built in insecticides?), and an effective *mild abrasive*, for cleaning metal surfaces, such as molds.

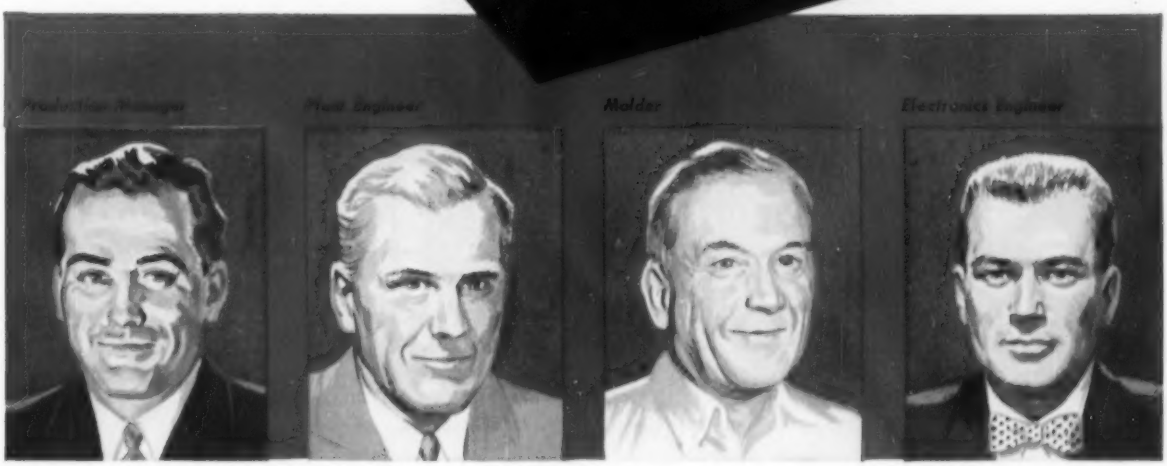
Other prospective uses include very fine filtration work; as a *binding agent* and *moisture absorbent* in ore processing; as an *anti-binding agent* to give desired porosity after burn-out in products like firebrick.

For samples, further information and specifications, please write:

DEPT. L-3C

Wilner Wood Products Co., Norway, Me.

what advantages do you gain with ATLAC Polyester Resin?



No warpage, faster production

"We had a high percentage of rejects due to warpage. By switching to ATLAC 382 we speeded up our molding cycle, and minimized warpage difficulties. Because ATLAC has a higher heat distortion temperature than most other polyesters, we don't have to wait for the molds to cool before pulling the pieces."

Atlac acid tanks are safer

"Breakage of vitreous and terra cotta acid tanks was a constant hazard in our plant. I suggested ATLAC 382 to my molder for tanks to hold dilute acids. Now, thanks to the high impact strength and acid resistance of ATLAC, we solved one of our big acid-handling problems."

Upgrades conventional polyesters

"When conventional resins don't measure up to a job, we upgrade them by adding ATLAC 382. It's easy to mix resins to the exact consistency needed for the job, and get the properties we want."

Higher heat distortion temperature

"For circuit construction, we wanted laminates that wouldn't buckle or warp when subjected to heat. We chose ATLAC polyesters because of their higher heat distortion temperatures, and get an important extra 50° F. of protection."

Write to Atlas for data and samples.

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flame resistant
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hygienic
easily dyed

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is sold, the salesman lifts out one of the panels and, using a small metal tool, stamps the sales date and guarantee expiration date on the connector.

Other similar top-quality replacement batteries have cases and covers molded in an attractive blue color, or blue cases with bright yellow covers.

Still another supplier uses cases molded of a specially formulated black modified styrene material which reportedly renders the batteries more competitive from the price standpoint. This supplier emphasizes a non-leaking thermosealed polystyrene one-piece cover, high-level-type container, more acid volume, quicker activation, greater capacity, and lighter weight.

Original equipment

The battery cases described above are being used only for replacement. Are the auto manufacturers overlooking a bet by not specifying plastic-cased batteries as *original* equipment? The auto makers seem to feel that the added cost of such a battery could not be successfully passed along to the buyer, who considers the original battery a purely functional rather than an "appearance" item. Unfortunately, much of the "plus" sales appeal of a colorful molded styrene battery case is lost once the battery has been installed in the car, since only the cover is then clearly visible. One battery looks pretty much like another from the top. But a cleanly designed, colorful case of a battery on display as a replacement unit can go far toward clinching a sale—especially when it can be pointed out that this "beauty battery" has a longer guarantee, extra capacity, and other top quality features not offered by many competitors.

Credits: For cooperation in supplying information on which the foregoing article was based, the editors wish to thank the following injection molders, battery manufacturers, and battery distributors: Plastics Div., General American Transportation Corp.; The Richardson Co.; Gould-National Batteries, Inc.; Montgomery Ward & Co.; Pure Oil Co.; and Western Auto Supply Co.

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Great Britain

(*From pp.* 188-191)

annum, the potential importance is such that I.C.I. announced last year its intention of building a new 20,000,000-lb. plant near Wilton. The interest of current trends in this field is not so much in the extended consumption of nylon materials as it is in the growing number of nylon-type polymers which are now being made available to meet the specialized requirements of consumer and industrial life.

For some years the chemical engineering of Britain's plastics industry was far ahead of its mechanical engineering, particularly in the injection field which was one of missed opportunity for Britain 20 years ago at the time when the controlling Eichengruen patents were running out.

The extent to which British engineers have made up the lost ground was evident last year, when for the first time British machines stood side-by-side with the cream of German engineering production at the Düsseldorf exhibition. While much has been said about the advantages of the fast-cycling small machine, recent interest has been focussed at the other end of the scale by the appearance of the 160-oz. Windsor and PECO machines. The latter, manufactured by Projectile and Engineering Co., is said to be the largest of its type to be produced outside the U.S., and employs what has been described as "in-line" preplasticization, claimed to be a new idea in injection molding. This innovation, while embodying the advantages of other units of this type already in production, is claimed to be simpler in operation and capable of controlling the molding variables to much closer tolerances.

Outlet for resin

The production of resin-bonded chipboard has now attained sizable proportions in Britain, but hitherto commercial production has been based on the use of conventional multi-day-light presses. During the year the first Bartrev continuous press commenced commercial operation, and proved the practicability of the idea which has cost 15 years of intensive research to perfect, with a production of the order of 50 tons of chipboard per day from a single unit. The new process could furnish a good outlet for plastics, even though the actual resin content of the sheet is only of the order of 5 to 7 percent.

Applications

In general, the structural use of plastics in Britain has lagged behind that in America and Germany. Plastics here have been used more for "cladding" other materials, as exemplified by the vinyl-coated metal fan blades illustrated on p. 189. However, there has been some progress in all-plastics design in the past year.

It is possibly in the field of consumer goods that the application of plastics made greatest progress in Britain in 1955. This

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was, in part, due to the fact that informative labelling of products by the manufacturers has now introduced the housewife to plastics as individuals, whereas hitherto she had known them only as a family. As a result, a housewife who would not previously buy plastics has bought polyethylene kitchen units and found them wonderful. It is not surprising, therefore, that the British market carries a wide array of well designed kitchenware, mostly of polyethylene, headed by a waste bin weighing 90 oz. and a dish pan 24 in. in diameter.

Blow molding

The blow molding of polyethylene is another line which has recently shown considerable progress, both for decorative and utility articles. These are produced by what is basically the Plax process, operated under license by Cascelloid, the controlling patent for which was extended during the year. This may result in a clarification in Britain of the patent position in this field. An interesting novelty produced in this way by Cascelloid is the lemon juice container illustrated on p. 190, of which over 6,000,000 units have already been sold to British housewives at the time of this writing.

It must not be assumed that the British market favors only polyethylene. The vinyls are well established in consumer acceptance. Improved styrene formulations are extending the market for that material. Urea had held its own, but melamine is appearing in more and more kitchen products. It is generally accepted here that whatever uses plastics can meet, they cannot be used for the production of units which have to sustain heat. The use of a urea molding as an electric fire surround, though not strictly in the latter category, was none-the-less very interesting. (See p. 189.) But while plastics have not been too frequently accepted where heat is involved, in Britain they are wholeheartedly approved where resistance to cold is concerned, and they are being put to wide application here in the construction of refrigerator components.—END

MARVEL Synclinal FILTERS

For Efficient Filtration of--

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Water

SUMP TYPE (cutaway)

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Meet J. I. C. Standards

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MP-6

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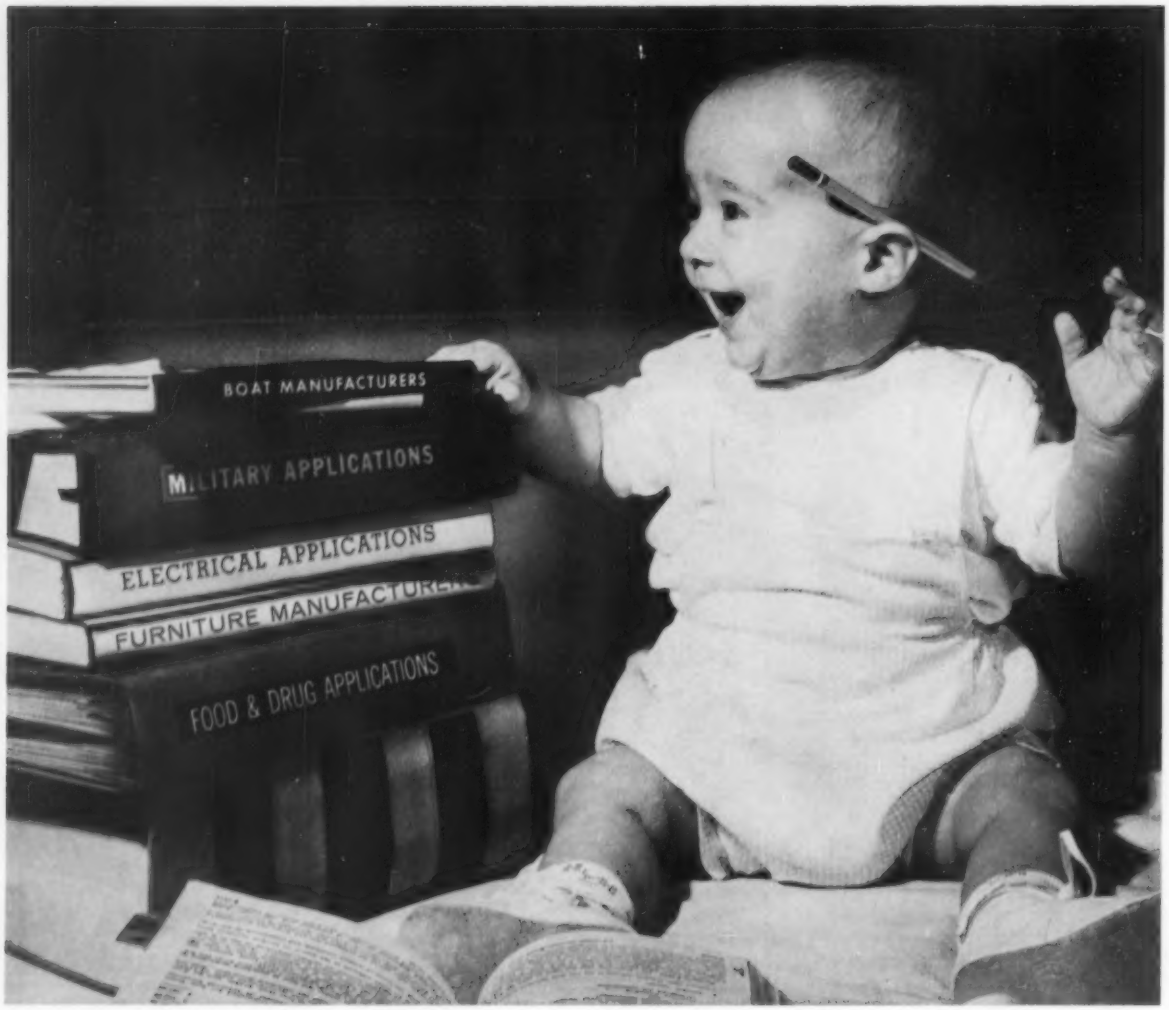

"Yes, sir—one year old and just look at Troytuf's record!"

JUST one year ago, we introduced Troytuf Dacron* Blanket for reinforced plastics. Now, on Troytuf's first birthday, we have volumes of evidence that this new reinforcing material is ideally suited to a wide variety of molding and laminating uses. Manufacturers in many fields—furniture, boats, and electrical equipment, for example—are in actual production on Troytuf-molded items or are running experiments.

They have found that Troytuf laminates are light in weight, strong, and have excellent drawing, machining, and dielectric qualities. Troytuf laminates also demonstrate good abrasion resistance, form strong interlaminar bonds, and *never* wick.

*Du Pont trademark

SAMPLES—Troy Blanket Mills will gladly supply full details and samples of Troytuf Dacron Blanket for experimental molding, without obligation.

REINFORCING **Troytuf** BLANKETS

Troy Blanket Mills, 200 Madison Avenue, New York 16, N. Y.

COLORS

for ALL Rubber and Plastics Compounding Requirements

*STAN-TONE

provides the Specific answer for every technical need in Color Compounding–

To assure faster pigment incorporation, cleaner color and more color permanence in the finished product . . .

***STAN-TONE PC - Paste . . .**
Color dispersed in plasticizer for organosol, plastisol and calendered vinyl resins.

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Color dispersion in low molecular weight polyethylene for polyethylene, rubber and vinyls.

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Colors plastic dispersed. Standardized in color intensity for precision color matching, cleaner compounding.

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Write for complete technical data on colors for any need.
*** STAN-TONE is a name registered by Harwick Standard Chemical Co.**

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STAN - TONE - PC WHITE PASTE
Titanium-White dispersed in DOP and Paraplex G-50

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Ideal backing for pressure sensitive surfaces

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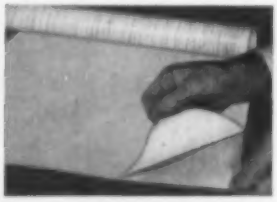
In the manufacture of corrugated polyester fiberglass sheets, Patapar gives "satin" finish



Easy release from pressure sensitive plastics

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peel off easily from pressure sensitive and tacky surfaces

New types of Patapar Vegetable Parchment provide a low cost release material that peels off easily from all kinds of tacky surfaces and pressure sensitive adhesives.

The new Patapars are outstanding as a backing, liner, interleaver, overwrap, separator sheet, bakery pan liner, and many other uses.

FEATURES OF PATAPAR RELEASING PARCHMENTS INCLUDE:

- **dense, fibre free texture**
- **high resistance to penetration or migration of oil and softeners**
- **permanent releasing action.**

If the illustrations and comments on this page suggest a way that Patapar Releasing Parchments could be helpful in your business, write us telling the application you have in mind. We will send testing samples and technical data.

Why not write today?

Patapar®
Vegetable Parchment
HI-WET-STRENGTH • GREASE-RESISTING

HEADQUARTERS FOR VEGETABLE PARCHMENT SINCE 1885

Cutting costs

(*From page* 195)

inside surface of the end pieces of the metal unit (photo, p. 195). The function of the struts was to prevent the metal top from flexing under downward pressure. Since the problem of flexing no longer exists with the polyester-fibrous glass laminate construction, the struts can be mounted instead directly on the base plate where they serve primarily as fastening points for the cover.

And this improved strength is attained in the face of lower weight! The plastics cover weighs just over 5 lb., about half the weight of its metal counterpart. Since the telephone unit is generally wall mounted, the benefits in handling and installation are many.

The plastic cover also has better sound-muffling properties than the steel unit. With the same thickness of insulating blanket inside the cover, the noise of relays and other mechanical devices transmitted through the cover is much lower for the reinforced plastic than for the metal case.

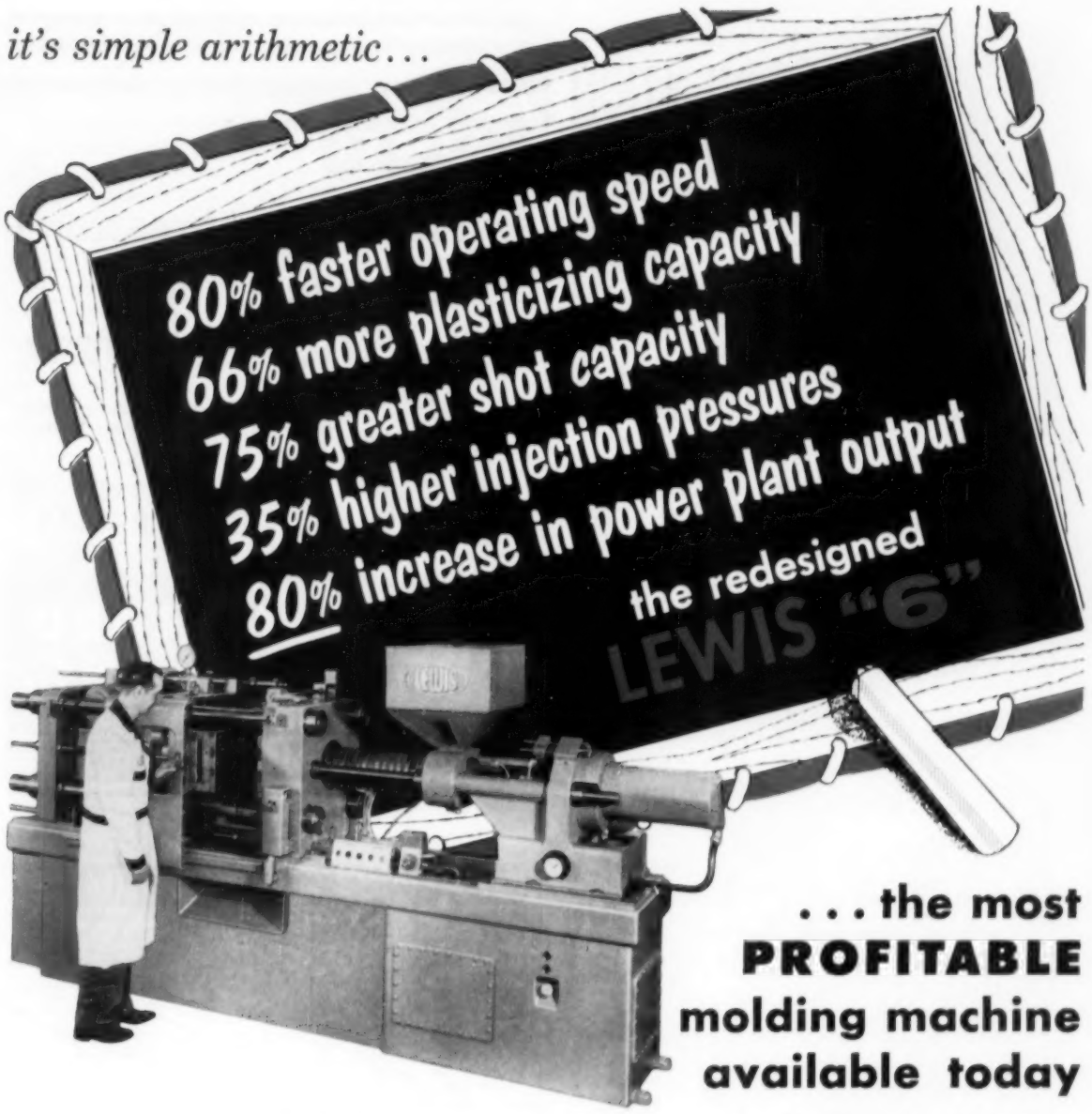
Finally, the reinforced plastic laminate, because of its inherent corrosion resistance, does not require the zinc chromate covering that had been necessary to protect the steel covers previously used.

How they are made

The polyester-fibrous glass covers are molded in matched chrome-plated, steam-cored Meehanite molds on a hydraulic press. About 15 covers are produced per hour. The fibrous glass mat which is used comprises about 46% of the total cover weight. Using wrinkle enamel and baking, a wrinkle finish, indistinguishable in appearance and texture from the finish which heretofore could be obtained only on metal, is applied to the cover in a separate operation after molding is complete.

Credits: Telephone unit manufactured by Western Electric Co.; covers molded by Winner Mfg. Co., Inc., Trenton, N. J.; Paraplex P-49 polyester resin supplied by Rohm & Haas Co., Inc.

it's simple arithmetic...



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No matter *how* you figure it . . . in terms of initial investment, versatility, production capacity, quality of moldings, percentage of scrap or operating and maintenance costs . . . the completely redesigned LEWIS Model 616-L-12 is tops in its class.

As the latest development in the LEWIS "6" series, Model 616-L-12 dry cycles 450 times per hour, molds up to 20 cubic inches per shot, plasticizes 100 pounds of material per hour, shoots 12 ounces of polystyrene with pre-packing.

This new LEWIS "6" is engineered for cost and quality-conscious production molders. Dollar for dollar, there's none to compare.

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FOR ADDITIONAL DETAILS, WRITE FOR BULLETIN 105 . . . OR CALL KEnmore 1-3040.

THE LEWIS WELDING & ENGINEERING CORP.

MACHINE DIVISION

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6836-LWM

Lewis Welding & Engineering Corp.
Machine Division
23002 St. Clair Ave., Cleve. 17, O.

Please send BULLETIN 105 describing Model 616-L-12.

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COMPANY _____

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Headquarters for
DRY COLORANTS
for polystyrene and polyethylene
MOLDING COMPOUNDS

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TECHNIQUES

H. Kohnstamm's Dry Colorants combined with the simple, fool-proof Kohnstamm techniques are recognized throughout the world. Continuous consultation with leading molders who use our self-measuring, fool-proof colorants is your assurance of employing the most advanced and economical methods of integrating color and plastic ready for molding.

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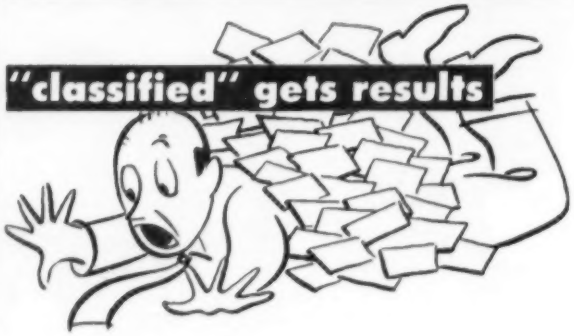


There's always been a lively market for used plastics processing equipment. At this moment, it is probably more active than at any time since 1950. One of the prime movers of this "second hand–first quality" machinery is the Classified Advertising Department of Modern Plastics.

"Classified" rates, for either buyers or sellers, are very reasonable. Check them now, on page 472 of this issue.

Classified Advertising Department

MODERN PLASTICS

575 Madison Avenue New York 22, N.Y.

Protective coatings

(From pp. 252-254)

cannot be completely screened out by a colorless coating, less protection would be expected with a colorless than with an opaque coating.

Pigmented coatings

Pigmented coatings were outstanding in their protection of polystyrene. Aluminum and black pigmented polymethyl methacrylate coatings have withstood 6 yr. of outdoor exposure at Bound Brook without signs of failure (Fig. 2). Only a slight dulling has been noted after 5500 hr. of Atlas Weather-Ometer, type X1A exposure[3] for the black and 9800 hr. for the aluminum-filled coatings. Coated polystyrene monofilaments were unchanged by hand tests and appearance after 18 mo. of outside exposure. Uncoated monofilaments were brittle and weak after 12 months. Similar results were obtained from X1A exposures of aluminum-coated monofilaments in which the coated samples were strong after 7500 hr., and the uncoated samples were weak and dull after 800 hours. Polystyrene screening protected with aluminum, brass, and carbon black-pigmented coatings has remained strong and flexible through 3½ yr. outdoors. On the other hand, uncoated screening became brittle and weak after 15 mo. of exposure. Accelerated exposures through 4500 hr. gave identical results, as illustrated in Fig. 3, p. 254.

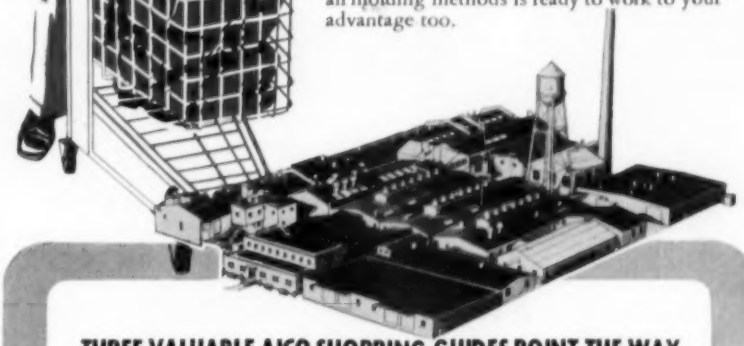
The samples discussed above were given only a single coating just before weathering. In applications where additional infrequent coatings could be applied, the appearance of the piece and its mechanical properties could probably be maintained indefinitely. Since second coatings adhere well to a primary coating and the lacquers can be applied by brushing, dipping, or spraying by simply adjusting solvent content, there should be no difficulty in painting polystyrene articles whenever necessary.—END

[3]Samples are rotated, through a water spray at one point, at a 35 to 40°C. temperature. The light source is a carbon arc filtered to approximate the sunlight at the earth's surface (A.S.T.M. D 822-46T).

Here's One-Stop Shopping For All Your Molded Plastic Needs... A

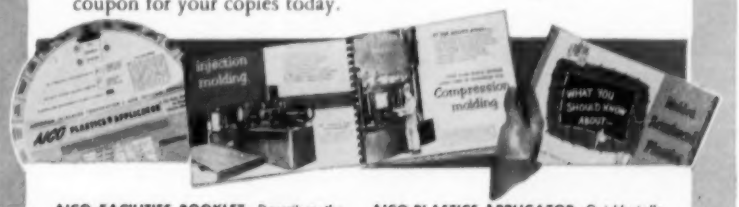
Super Market FOR CUSTOM Molded Plastics

Here at AICO you will find, under one roof, a complete one-stop shopping service to provide product improvement, quality refinement and reduction of costs through the proper application of molded plastics. Since 1916, AICO has been a major supplier of molded plastic components to many of America's leading manufacturers. AICO's unequalled experience with every type of material and all molding methods is ready to work to your advantage too.



THREE VALUABLE AICO SHOPPING GUIDES POINT THE WAY

To see if you should convert your particular products to plastics, send for the 3 AICO Shopping Guides to the profitable use of plastics shown below. They're free... No obligation. Mail coupon for your copies today.



AICO FACILITIES BOOKLET: Describes the equipment needed to provide a complete molding service. Serves as a valuable guide to selecting a single, fully-equipped molder to do your work, and thus avoid the annoyance and waste of split responsibilities.

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A COMPLETE PLASTICS MOLDING SERVICE including engineering, mold building, compression, transfer, injection and cold molding plus the molding of Reinforced Fiberglas.

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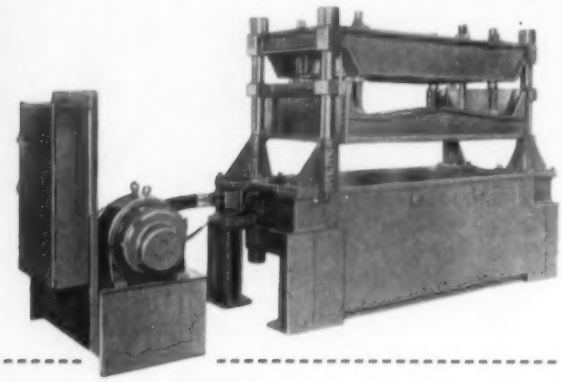
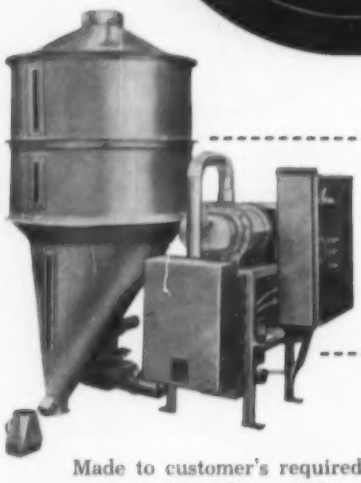
PLASTICS equipment

100 TON LOW HEIGHT MANUALLY OPERATED PULL-DOWN TYPE TRIMMING PRESS

Pressure Capacity ..... 100 tons
Pressing Area ..... 48" x 96"
Other capacities and sizes to suit your requirements.





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Tube-type revolving agitator gives off heated air through main shaft and through arms to speed drying and blending.

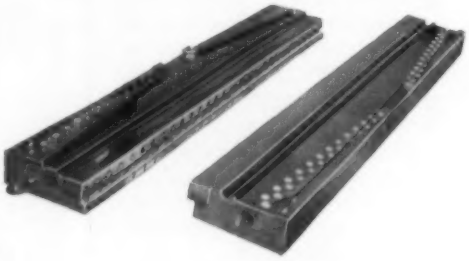
SHEETING DIE

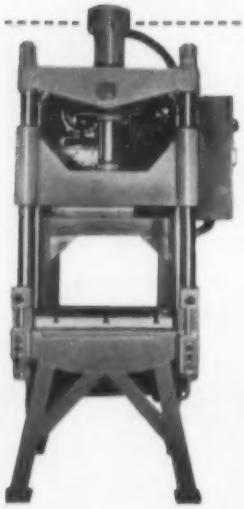
Made to customer's required lengths, equipped with lips to produce sheets from .020" to .1875" thick.

All interior surfaces chrome plated and highly polished.

Restrictor bar distributes material evenly throughout die, permitting better temperature and gauge control.

Heating elements—¾" diameter x 6" long, 350 watts, wired in zones.





20 TON MANUALLY OPERATED PUSH-DOWN TYPE TRIMMING PRESS

Pressure Capacity ..... 20 tons
Pressing Area ..... 20" x 30"
Other capacities and sizes to suit your requirements.

Thinking about AUTOMATION?

We've had extensive experience designing and building automation equipment for the metal and plastics industries. Why not get in touch with our Engineering Department—and learn how automation can improve **your** operation. Let us quote your trim die requirements.

Write for FREE literature, showing complete specifications and operating features of this equipment.

Goulding MANUFACTURING CO.,

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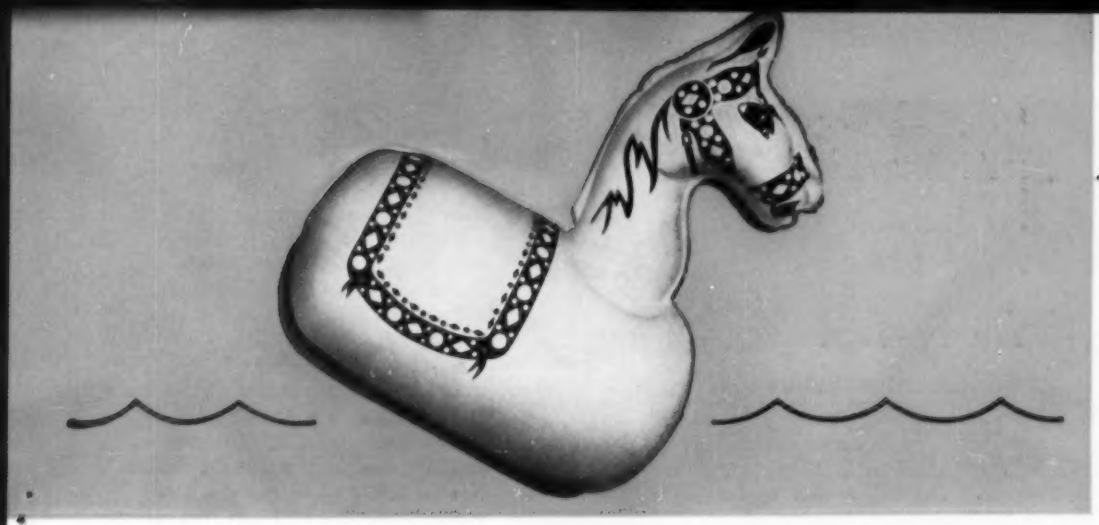

For long-lasting whiteness, specify easily dispersible

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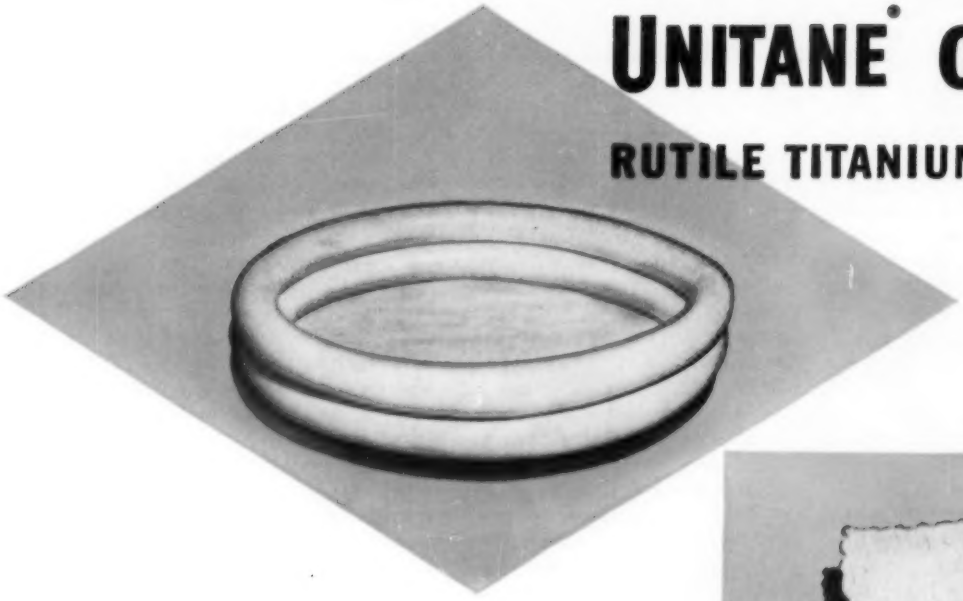

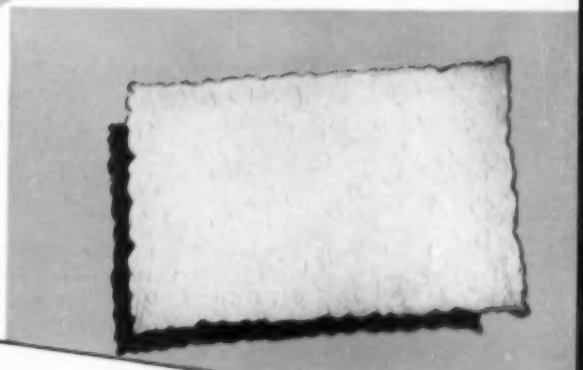

Whiteness, brightness and opacity, stability to heat and light, freedom from hard-to-disperse clusters—all of these combine to make UNITANE OR-342 rutile titanium dioxide the white pigment choice in high-quality plastics.

UNITANE OR-342 is carefully processed and check-tested to maintain soft texture and easy dispersion—a quality you must have for perfect polyvinyl sheeting; a quality that means economy in all plastics compounding.

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PIGMENTS DIVISION

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BRANCH OFFICES AND WAREHOUSES IN PRINCIPAL CITIES

The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 37)*

Plastics at Packaging Show

Transparent packaging. Self-service in retail outlets has probably been the most powerful accelerator to transparent or "visibility" packaging since packaging became an identifiable branch of industry back in the mid-1930's. The wonderful thing about self-service, so far as plastics are concerned is that, big as it is, it is destined to become much bigger. Even shoe companies are desirous of selling children's shoes in transparent packages in supermarkets and that example could spread to scores of other items. The skin-pack idea, for example, has such great potential that it is impossible to conceive of the volume of plastics which will be used for small items such as nails, screws, bobby pins, maybe even pills, in the visibility-package market. And this entire self-service visibility-packaging market seems largely dependent upon plastics. Translucency is included with transparency in this case because even a translucent package gives the customer a glimpse of what he is getting.

Styrene in throw-aways. A direct result of self-service merchandising is the use of an amazing amount of polystyrene for packaging. Samples of thin-walled containers, either molded or vacuum formed, were much in evidence at the recent Packaging Exposition at Atlantic City. A shallow tray-like container, vacuum formed of 0.015-in. high-impact, natural-color polystyrene, with a lid that locked on tight and seemed almost as flexible as polyethylene, was outstanding. It was made by a continuous automatic process from extruder through vacuum former to finished product. And there was the injection-molded cup with wall sections only 0.016 in. thick, made of impact material by a completely automatic molding process.

These are high-speed, low-cost, mass production jobs. The end products are use-once, throw-away items. Cooperation between machinery producers, molders, and food processors in a more thorough development of this idea could result in a vast volume of business for all of them. The use of low-cost styrene-type materials for packaging was undoubtedly one of the strongest plastics undercurrents at the Packaging Exposition.

Cellulose acetate film was the first plastic to feel the impact of visibility packaging. The introduction of skin and blister packs has added millions of pounds to acetate production volume. And now it is going into big packages —a 9- by 12-ft. piece of floor covering, rolled and wrapped in a 3-mil thick acetate film was offered as evidence at the show. The film was used strictly for appearance—"sales appeal." It worked. The manufacturer claimed a 90% increase in sales after the acetate package was adopted.

New this year are paint brushes wrapped in acetate; and neatly printed film is being made into "brief cases" for carrying pajamas. An "old" use that has picked up added impetus is acetate laminated to cardboard or paper, or used as a window with cardboard boxes. The latter type package with a small area of board and a large area of transparent film is not new in merchandising but is rapidly becoming a more important part of the visibility-packaging trend. Acetate fits in well because of its strength and clarity. Acetate laminated to paper is gaining ground as a Christmas gift wrap. The producer of the gift can wrap it months before Christmas without fear of deterioration of the wrapper before the holiday season; in some cases he can even skin-pack with this combination.

Polyethylene was probably the most talked about of all plastics at the show, as it has been for two or three years, but the film applications were mostly just more of what has been seen before. A new Molten Bead Sealer attracted considerable attention. It extrudes a hot filament of polyethylene between two layers of film instead of drawing heat through the film and could operate at a speed of over 400 ft./min.

The use of polyethylene as a laminate or coating for other materials has apparently made considerable progress in the last year. As a coating for paperboard milk containers, and as a liner for 10-gal. paperboard containers, polyethylene will apparently become a most useful handmaiden to the dairyman. And as a circular squeeze container for insecticides, detergents, and talcum powder, polyethylene has found another millions-of-pounds market. The list of polyethylene uses in packaging could go on indefinitely.

Saran use in packaging candy, meats, cheese, and in windows in ice cream packs is growing steadily. Sliced meats can now be packaged in saran film at the retail level, using automatic machines. Heavy items such as hardware, new on the saran film list, are using the film because of its clarity and strength.

Vinyl. Extruded vinyl film's use has spread out rapidly in the soft goods field and it is now being used for protection of books and as window shade wrapping. Price has dropped to a range of from 78 to 87¢ a pound.

Mylar was emphasized for use as a thin film for heavy packages or extra strong windows. A novel use is as a container for precooked foods that can be warmed up in

* Reg. U. S. Pat. Off.

NEW! Swedlow Heat-Reflective Plastic Laminate

protects vital instruments in North American Aviation's F-100

The recently developed Swedlow laminate X5G-138-101 forms the shield to protect the critical wiring in the after-burner area of North American Aviation's F-100 Super Sabre from the tremendous heat generated by the jet engine. This light-weight laminate (.0625" thick, weighing .530 pounds per square foot) shows a temperature drop from 1200°F on one face to 560°F on the other face after prolonged exposure. This remarkable material is also far easier to mold and fabricate than any previously available. For further information, contact the Swedlow plant nearest you.

Swedlow PLASTICS CO.

LOS ANGELES, CALIFORNIA • YOUNGSTOWN, OHIO

The Plastiscope

the bag. If this item goes over, it could lead to tremendous volume —a development that could possibly lead to the use of film as a replacement for cans and bottles.

Equipment company expands

A new plant on a 7-acre tract in Fords, N. J., will soon be occupied by Prodex Corp. The firm, which formerly operated within the framework of Industrial Synthetics Corp., Garwood, N. J., became completely independent when Industrial Synthetics Corp. was sold to American Hard Rubber Co.

Prodex makes compounding, extrusion, milling, and mixing equipment. It has made extrusion screws as long as 14 ft. and is now planning the manufacture of 2½- to 8-in. extruders for the trade. The firm has equipped various plants in Europe.

Albert A. Kaufman, president, states that he has a new type of 2-in. extruder now on the drafting board and expects to make it available in a year.

Officers of Prodex are as follows: Albert A. Kaufman, formerly president of ISC, is president; Arthur F. Scarpa, previously production manager of Hartig Engine & Machine Co., is vice president; and Frank R. Nissel, formerly a calendering and take-off equipment specialist of Bakelite Co., is sales manager.

Adhesive Teflon tape

Pressure-sensitive Teflon tape No. 549, developed by Minnesota Mining & Mfg. Co., St. Paul, Minn., is claimed to combine all the properties of Teflon film with the chemical and heat-resistant properties of a pressure-sensitive adhesive.

The semi-transparent, blue-gray tape is designed for ready application to a wide variety of surfaces. Used as a cover on the jaws of heat sealing equipment, for example, it gives good release properties and offers chemical protection to the sealing jaw surface.

The tape, made in both a 3½- and 6½-mil thickness, consists of 2- and 5-mil films coated with 1½ mils of silicone adhesive. The 3½-mil tape has 200% elongation and tensile strength of 25 lb./in. of tape width; the 6½-mil tape offers 150% stretch and 40-lb./in. tensile strength. Both tapes are said to be unaffected by temperature changes within the range of −65 to 400° F. continuously (457° F. intermittently) and to offer good conformability at all times. Teflon tape No. 549 is being made available nationally in ¼- to 5-in. widths in 36-yd. rolls.

New pigments

Addition of a strong, phthalocyanine green toner to its line of pigments has been announced by American Cyanamid Co.'s Pigments Div., 30 Rockefeller Plaza, New York, N. Y.

Designated Cyan Green Toner 15-3100, the pigment is claimed to be essentially non-bleeding in organic solvents and have color stability in both acid and alkaline media.

Another pigment development, called Brilliant Toning Red CP 1269, has been announced by The Sherwin Williams Co., Chicago, Ill. Based on beta-oxy naphthoic acid, it is of the type known as Permanent Red 2 B.

Toning Red CP 1269 is said to be 15% stronger and brighter than equivalent pigments; to be easily dispersed; to exhibit no migration, crocking, or bleeding in plasticizers, water, or solvents; and to maintain its shade even after exposure to high heat.

Copper-clad fluorocarbon

Using a special bonding technique, International Resistance Co., 401 N. Broad St., Philadelphia, Pa., has cladded fluorocarbon plastic with copper, without the use of a resin adhesive. The resulting laminate is claimed to exhibit very low cold flow, zero water absorption, good machinability, and a water-repellent surface; the fluorocarbon base is said to be unaffected by acids, alkalies, or common organic solvents.

Fluorocarbons are inherently more flexible than thermosets currently used in copper-clad laminates, and the new laminate is recommended for use under severe temperature, moisture, and electrical conditions.

Improved phenolic available

Commercial availability of an improved impact black phenolic molding compound has been announced by General Electric Co.'s Chemical Materials Dept., Pittsfield, Mass. Said to have an Izod impact range of 0.40 to 0.44, the new phenolic, G-E 12906, is nevertheless reported to be suitable for automatic molding processes.

Other improvements claimed by G-E include uniform pill weight and excellent preformability in tabletting machines. Filled with wood flour and cotton flock, the compound reportedly produces molded parts with finishes superior to conventional improved impact materials, in both cold powder and preheat uses.

Reinforced sheet standard

A new standard covering a reinforced plastics sheet laminate for mechanical and electrical applications has been adopted by the National Electrical Manufacturers Association, the American Society of Testing Materials, and The Society of the Plastics Industry, Inc. This standard is for a general-purpose grade of polyester-glass mat sheet laminate.

The new GPO-1 standard was originally drawn up by a joint N.E.M.A.-S.P.I. committee after consultation with the principal manufacturers involved. It follows the same pattern as the existing N.E.M.A. standards for phenolic and melamine sheet materials.

Specified in this standard are control values for essential physical and electrical properties for a glass mat-reinforced polyester sheet laminate intended for use at elevated temperatures as required of Class B electrical in-

AMPACET

(All Thermoplastic Materials)

SPECIAL EFFECTS

1

★ Confetti Tinsel
★ Pearl
★ Phosphorescent
★ Iridescent

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2

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★ Phosphorescent
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(color concentrate)

3

for
★ Polyethylene
★ Polyatyrene
★ Vinyl

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in toy colors, silver, black

4

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The Plastiscope

sulation. Only the most essential and most easily measured properties have been covered in the initial standard.

Copies of the standard are available from either The Society of the Plastics Industry, Inc. or the National Electrical Manufacturers Association.

New name for melamine

Melamine molding compounds and resins produced by American Cyanamid Co.'s Plastics and Resins Div. will henceforth carry the tradename Cymel. The company's mineral-filled melamine molding compound, formerly referred to as Melmac 592, now is known as Cymel 592; one of its laminating resins, formerly Melmac 405, is now referred to as Cymel 405.

Cyanamid's tradename Melmac henceforth will refer only to melamine dinnerware manufactured by molders who have been granted permission to use the name by Cyanamid.

Lacquer for cellulose acetate

A lacquer for coating and decorating cellulose acetate, called Rez-n-Lac A, has been developed by Schwartz Chemical Co., Inc., 326 W. 70th St., New York, N. Y. The base resin is claimed to be non-toxic, permitting use of the lacquer on children's toys and other objects which come in contact with the body.

According to the manufacturer, Rez-n-Lac A will not flake, brittle, or craze. It is available in all standard colors, either opaque or transparent, in 1- and 5-gal. cans and 55-gal. steel drums.

High-vacuum symposium

The third symposium on vacuum technology will be held by the Committee on Vacuum Techniques, Inc., at Hotel Sheraton, Chicago, Ill., from October 10 to 12.

Papers are invited for presentation with particular emphasis in the following categories: Fundamental developments in vacuum technology; methods and techniques for obtaining high vacuum; instrumentation and control of high-vacuum equipment; vacuum distillation and evaporation; metallurgical and chemical applications; and vacuum technology as related to atomic energy and extra-terrestrial problems.

Correspondence regarding proposed papers should be sent to the program chairman, Dr. E. S. Perry, Distillation Products Industries, 755 Ridge Rd. W., Rochester 13, N. Y.

Showroom for eyeglass frames

A new showroom is now open to visitors to Nixon Nitration Works, Nixon, N. J., where optical designers can see how Nixon Plastics has developed its ophthalmic and sunglass materials over the years.

Samples of acetate, butyrate, and nitrate are displayed in showcases around the room. Nearly 2000 colors, shades, and styles are on view. They include the variegations, multiple lay-ups, striations, laminations, pearls, opaques, translucents, and transparents.

Hexa from Merck

Two grades of hexamethylenetetramine—technical granular and technical powder—are now available from the Chemical Div. of Merck & Co., Inc., Rahway, N. J. The product is a standard hardening agent for plastics and a curing agent for synthetic rubber.

Both grades are supplied in minimum truck-load quantities of 20,000 pounds.

Low-pressure polyethylene

Plans for building a commercial plant for the production of low-pressure polyethylene have been announced by Societé des Usines Chimiques Rhône-Poulenc, Etablissements Kuhlmann, and Compagnie Française de Raffinage (C.F.R.). These firms will work together under a license which was recently granted by Phillips Petroleum Co. to Rhône-Poulenc for the exclusive use in France of the Phillips-developed process for making polyethylene.

The plant will be located on a site adjacent to the C.F.R. Refinery, Gonfreville, near Le Havre, Normandie. Raw Material for the ethylene production will be supplied by C.F.R. from its Gonfreville Refinery.

Vinyl promotion

A nation-wide promotion and advertising campaign for Pantasote Premium plastics has been instituted by The Pantasote Co., 444 Madison Ave., New York, N. Y., in cooperation with converters and plastics manufacturers. The campaign includes a contest, the winner of which will receive two round-trip flights from New York to Paris, plus $250 for expenses. There will also be cash prizes.

Panelyte in new colors

Eight new colors for Panelyte decorative laminates have been announced by St. Regis Paper Co., 230 Park Ave., New York, N. Y. Styled by color consultant Elizabeth Burris-Meyer, the colors are citron yellow, carnation pink, flame, cerulean blue, middy blue, dove gray, cantaloupe, and bitter green.

In addition to its new line of solid colors, St. Regis Panelyte is available in stippletone, linen, "Harvest," wood grain, and other patterns.

New wire insulation

A new magnet wire insulation material, particularly for use on solderable wire, has been announced by Shawinigan Resins Corp., Springfield, Mass. The material is based on a combination of Formvar polyvinyl formal and urethane. The company does not manufacture the insulation material but supplies the Formvar resin to wire enamel manufacturers.

According to W. H. Bromley, director of development, Formvar-urethane gives exceptional coatings with respect to solderability at low temperatures, resistance to thermoplastic flow, low extractible content, and re-

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sistance to softening by refrigerant Freon 22. The compositions referred to as Formvar-urethanes employ Mondur-S produced by Mobay Chemical Co. in place of the usual phenolic modifying resin.

Formvar-urethane wire enamel is not designed as a replacement for the standard Formvar-phenolic combination but is intended to supplement it in applications where special properties such as solderability are necessary.

New wall tile

What is claimed to be a new style in polystyrene wall tile has been introduced by Wilson Plastics, Inc., Sandusky, Ohio. It has a fluted surface with a different texture than usual, obtained by combining a granite-type surface with three soft, parallel surface flutes. Checkerboard, inlaid, and striped effects can be achieved without resorting to a change in tile color.

Spencer Poly-Eth prices

Two changes in prices of Spencer Chemical Co.'s polyethylene have been announced. Poly-Eth 3215 for pipe use has been been improved in quality and now carries the National Sanitary Foundation approval; the price has been advanced from 35 to 37½¢ per pound. Poly-Eth 5005, a new resin for electrical insulation, is being offered at 37½¢ per pound.

New custom molder

A new entry in the plastics field, Wyatt's Plastics, Inc., has completed its plant in Houston, Texas, and will now be engaged in the custom molding of plastic and rubber products. The new company, which is a subsidiary of Wyatt Metal & Boiler Works, will adjoin the site of the parent organization at 5928 Katy St.

Carl J. Eckenrod has been appointed plant manager. He formerly held a similar position with Wright Mfg. Co., Houston, whose plastics division became the nucleus of Wyatt's Plastics. When the Wright firm was sold last year, its plastics division was purchased by Wyatt's.

The plant is equipped for compression and transfer molding of all thermosetting materials. Among its proprietary items is a cleat for a football shoe.

Adhesive for urethane

A liquid adhesive for bonding polyurethane foams to themselves, to paper, and to fabrics has been developed by The Borden Co.'s Chemical Div., Resinous Reslac Dept., Peabody, Mass. Designated Arcco C 518, it is offered at brushing viscosity but may be thinned for spray use.

Polystyrene-cased battery

Approval by Underwriters Laboratories, Inc. of the first storage battery designed specifically for emergency lighting has been received by Exide Industrial Div., The Electric Storage Battery Co., Philadelphia 1, Pa. The company believes that its unit is the first plastic-cased battery to be so approved. Previously, U/L accepted storage batteries only if encased in glass or opaque vulcanized rubber.

Wall tile with pearl effect

Shell-tone styrene wall tile with a pearl effect finish is being produced by Guildcrest Corp., 2938 W. 63rd St., Chicago, Ill. It is claimed to have a soft, silky appearance regardless of the angle of incidence.

The tile, 8½ by 8½ in., is being offered in white, green, yellow, rose, and blue.

Report on plastics course

Twenty-five students have enrolled in the injection molding course offered by the Special Courses Div. of Newark College of Engineering, in cooperation with the educational committee of the Newark Chapter of Society of Plastics Engineers, Inc. This number is the limit set by the college for the size of the group. The course, offered in 12 weekly sessions, covers machines, molding techniques, material preparation, instrumentation, and other aspects of the injection molding process; it also includes a plant visit to show the injection molding process in actual operation.

According to C. H. Stephans, director of Special Courses, all students in the course are currently employed in the plastics industry and expect to up-grade their status in the industry by virtue of having taken the course.

One of the expected results of the course is the development of text material and ultimately text books for use by any school giving a course in plastics.

While the course on injection molding can be taken separately, it is also part of a three-year course of study in plastics engineering technology leading to a certificate of achievement in that field.

A course to be offered for the fall term will cover extrusion. Enrollment is reserved primarily for applicants in the New Jersey area. Full details on these programs may be obtained from Clarence H. Stephans, director of Special Courses, Newark College of Engineering, 365 High St., Newark 2, N. J.

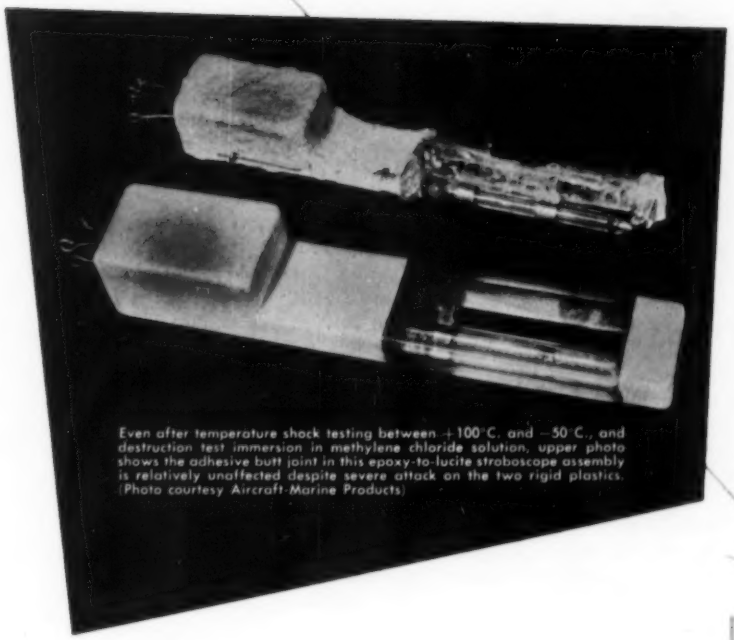
Research in polyesters

A contract has been granted to Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn., by the U. S. Department of Agriculture to investigate the incorporation of tung oil and tung fatty acids in polyester resins to develop new high-strength resins for industrial uses.

Bondable fluorocarbon sheet

Fluorocarbon film and sheeting specially treated on one or both sides to allow bonding to a variety of materials or to itself using commercially available adhesives has been developed by Shamban Engineering Co., 11617 W. Jefferson Blvd., Culver City, Calif.

Bondized Califilm (fluorothene or Kel-F) film and Kelon-F (Kel-F) sheets are claimed to be cementable to plastics, steel, aluminum, wood, cardboard, or



Even after temperature shock testing between +100°C. and −50°C., and destruction test immersion in methylene chloride solution, upper photo shows the adhesive butt joint in this epoxy-to-lucite stroboscope assembly is relatively unaffected despite severe attack on the two rigid plastics. (Photo courtesy Aircraft-Marine Products)

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rubber, and are recommended for liners, coverings for tanks, jigs and fixtures, rollers, bushings, loading hooks, sliding surfaces, pipes, ducts, valve facings, and machine parts.

Bondized Califilm is available in thicknesses from 0.005 to 0.015 in. in widths up to 16 inches. Bondized Kelon-F sheets are offered in thicknesses from 0.015 to 0.250 inch.

Semi-rigid epoxy

Developed by Furane Plastics, Inc., 4516 Brazil St., Los Angeles, Calif., a new modified epoxy resin system, Epocast 15, is designed for electronic insulation applications requiring a semi-rigid, low-modulus material with high electrical resistance throughout the temperature range of −65 to 300° F.

According to the manufacturer, Epocast 15 offers a low-strain-inducing insulation medium useful for electronic potting, impregnating, and encapsulating. Adhesion to metals, ceramic, and glass is claimed to be excellent.

The resin is being offered as a two-component clear impregnant and as a two-component filled potting and encapsulating medium. Epocast 15 has a pot life of three to four days at 80° F.; cure time is 6 hr. at 200° F. or 3 hr. at 250° F.

Plastic tooling research

A program of research on properties of plastics used for tooling applications has been initiated by the American Society of Tool Engineers Research Fund with the award of a $10,000 contract to the Purdue Research Foundation. Co-sponsors of the project include Bakelite Co., a Div. of Union Carbide and Carbon Corp.; Shell Chemical Corp.; Ciba Co., Inc.; and The Marblette Corp.

The Purdue Research Foundation will conduct the study in two six-month phases.

The first phase will involve a survey of existing literature and visits to plants experienced in plastic tooling applications. The second phase will be devoted to the establishment of standard test methods for measuring and predicting reactions of the variables involved (in order of importance): shrinkage characteristics, abrasion resistance, heat resistance, and physical properties essential in plastics for tooling in stamping and forming operations.

Additional studies will be made in each case to determine the specific results which may be expected when any one of the variables is altered. The final findings will then be compiled into a basic manual on plastic tooling.

Adhesives for packages

Nine adhesives specially designed to bond plastic packaging materials have been developed by Paisley Products, Inc., 630 W. 51st St., New York, N. Y. Paisley operates its own polyvinyl acetate resin emulsion plant.

Glass-silicone Formica

Development of a glass-silicone grade of Formica laminated plastic, claimed to have greater hot strength and better color fidelity, less water absorption, lower wet power factor, and higher dielectric strength than other laminates heretofore available, has been announced by The Formica Co., Cincinnati, Ohio.

Designated G-7-2, the material is said to be especially useful in printed circuits, guided missiles, radar, radio and television, motors and generators, and other electrical and electronic applications.

Epoxy tool resins

Three new types of epoxy resins that are claimed to be able to withstand hard wear and which are especially suitable for reinforced plastics tooling have been announced by Marblette Corp., 37-21 Thirtieth St., Long Island 1, N. Y.

Resin #602 is said to be particularly adaptable for draw dies and other metal-forming tools, routing fixtures, and foundry dies. The material permits fabrication of tools and dies without application of heat.

Resin #612-B is a die surface casting material.

Resin #613 is a coated material which when brushed onto a mold is reported not to run off vertical surfaces.

New tool resin maker

Formation of Hastings Plastics, Inc., 1551 Twelfth St., Santa Monica, Calif., has been announced. The new firm will manufacture and distribute a complete line of resins and related materials formulated for industrial applications in the electronic, low-pressure laminating, and plastic tooling fields.

Norry M. Hastings, formerly chief chemist and manager of product development of Rezolin, Inc., heads the organization. Hobart G. Hobbs, previously sales manager of Thalco Glass Fibers, Inc., will be in charge of sales.

Semi-finished polyethylene

An expanded line of polyethylene sheets, rods, bars, and blocks has been announced by American Agile Corp., Maple Heights (Cleveland), Ohio.

Sheets are now available in thicknesses from 1/16 to 1 in. in standard 44 by 72 in. size; rods from 1/2- to 12-in. diameter and standard lengths from 12 to 60 in.; bars may be obtained in thicknesses of 1/2, 3/4, and 1 in. in dimensions from 1 by 72 in. to 6 by 72 in.; and blocks from 1 by 12 by 12 in. to 6 by 12 by 12 inches.

Formica contact adhesive

Faster drying time and greater ease of spreading are claimed for Fast Dry, a new contact adhesive developed by The Formica Co., 4614 Spring Grove Ave., Cincinnati, Ohio, for fabricators and on-the-job installers of decorative laminates. The adhesive is also said to have increased resistance to heat, better early bond strength, and higher ultimate bond strength.

With the new cement, decorative laminates can be applied after only 15 min. of drying time,

Monsanto offers you a line of general-purpose styrene crystal that's completely

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Hi-Flow 55
(SOFT FLOW)

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Hi-Flow 66
(MEDIUM FLOW)

Lustrex
Hi-Flow 77
(STANDARD FLOW)

balanced

Lustrex Hi-Flow 55—a soft flow general-purpose styrene for *uniformly* thin wall applications like containers, and *uniformly* heavy sections like brush backs.

Lustrex Hi-Flow *66*—a medium flow general-purpose styrene that's ideal for thin-and-thick wall applications.

Lustrex Hi-Flow 77—a standard flow general-purpose styrene for quick set up.

Together these three formulations offer the industry the most *complete* range of general-purpose styrene compounds ever produced—from softest flow to quickest setting.

All Lustrex formulations are ready for immediate shipment in pelleted crystal. (Lustrex Hi-Flow 55 and Lustrex Hi-Flow 77 are also furnished in a broad range of colors and in colorant blend for dry coloring.) For colors and colorant blends in new Lustrex Hi-Flow *66*, consult your Monsanto representative.

In addition to general purpose styrene materials, Monsanto also supplies Lustrex LHA (medium impact); Lustrex Hi-Test 88 (rubber modified high-impact); Lustrex Hi-Heat 99 (with heat resistance up to 204° F.) and Lustrex LXC (a super high heat resistant copolymer for high heat applications).

Write today for data sheets. Address Monsanto Chemical Company, Plastics Division, Room **666**, Springfield 2, Mass.

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or in half the time required with formerly available adhesives. Fast Dry has a shelf life, guaranteed by Formica, of nine months under normal conditions.

Pine-gum products

Two new chemical products of pine gum, developed by U. S. Department of Agriculture scientists at Olustee, Fla., are now available commercially. The first, maleopimaric acid, has applications in products requiring a plasticizer, emulsifier, or resin. The other, pinane hydroperoxide (PHP), is a catalyst with applications in the production of certain plastics.

Eastman Kodak Co.'s Distillation Products Div. now carries maleopimaric acid in its stock of organic chemicals; American Cyanamid Co. has indicated that it can supply experimental quantities of PHP.

Cork-backed vinyl flooring

Flooring material consisting of a Cork-Tex underlay-vinyl tile laminate is now being manufactured by Robbins Floor Products, Inc., Tuscumbia, Ala. Cork-Tex underlay, a resilient sheet of resin-bonded cork, is produced by Bond Crown and Cork Div., Continental Can Co.

The tile surface is composed of heavy-gage vinyl in standard and decorator colors with the cork resin-laminated to the underside of the vinyl. The combination is claimed to make a long-wearing, attractive, low-maintenance floor which is particularly suited for high traffic areas such as office, school, and hospital corridors.

Reportedly, when laid on concrete, the cushioning effect of the cork underlay not only makes the tile more comfortable to walk on, but also reduces the noise factor about 80 percent. The price of the laminate is about the same as that of top-grade linoleum.

Foaming time

The following letter has been received from Joseph J. Hirsh, vice president, Foam King, Inc., concerning an item on page 35 of the

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If you are interested in quality vinyls, you owe it to your product; you owe it to your customers to use *Advance* ORGANO-TIN's. Why not try them soon? Samples and complete data are available. When writing, it would help us to make more intelligent recommendations if you described in a general way your stabilization problem.

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May issue of MODERN PLASTICS which related to that company's development of a new type vinyl foam:

"In your article you state that Foam King claims its method for foaming takes 10% less time than other methods . . . we state that 'The Foam King' process includes a method for the complete foaming action in heights up to 4 in. which can be accomplished in approximately 10% of the time previously required and not in 10% less time."

Becco to make epoxies

Three epoxy compounds—octylene oxide, dodecene oxide, and olefin oxide—have been developed by Becco Chemical Div., Food Machinery & Chemical Corp., Buffalo, N. Y. The new compounds, all long-chain epoxidized olefins, will undergo reactions such as polymerization, isomerization, reduction, and ring-opening with a variety of active hydrogen compounds.

The new epoxies are claimed to have a number of possibilities, such as solvents for epoxy resins; intermediates for perfumery; in surfactants and plastics; and as stabilizers for chlorinated compounds.

Addition to adhesives line

Oil resin adhesive M-200 has been added to the line of wall tile adhesives manufactured by The Macco Chemical Co., 30404 Lakeland Blvd., Wickliffe, Ohio. M-200 is claimed to have better characteristics than conventional adhesives selling at competitive prices.

The new product is available to all tile manufacturers under the Macco label or their private brand labels in 1-qt., 1-gal., 3½-gal. and 5-gal. metal pails.

Fibrous glass-epoxy tubing

A new method of producing tubing of fibrous glass-epoxy laminate has been developed by Lamtex Industries, Inc., 51 State St., Westbury, N. Y. Key stage in the process is the method of impregnating the raw fibrous glass with the epoxy resin. The company claims to have perfected an impregnation technique which results in high-quality laminates with physical, chemical, and electrical properties not previously available.

Insulated foil

A group of electrically insulated metal foils which are coated on one or both sides with Teflon has been introduced by American Machine & Foundry Co., 261 Madison Ave., New York, N. Y.

The trademark Amfoil applies to many different Teflon-coated metals, but the chief one is aluminum with coatings ranging in thickness from 0.03 to 0.5 mil per side. The foil is available in widths up to 40 inches.

New Pacific molder

Custom molding operations are now under way at Kennerley-Spratling, Inc., 1456 Fourth St.,

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United States Rubber

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Berkeley, Calif. The new company plans to specialize in compression, transfer, and injection molding, and offers wide experience in the application and production of plastics products.

Officers of the company are Fred L. Kennerley, president, and Ernest M. Spratling, vice president. Both principals have had over 25 years' experience in the plastics industry, and have worked together for the past 12 years as general manager and plant superintendent, respectively, at American Molding Co., San Francisco.

Plastic-metal compound

Designated Formex #77, a self-hardening plastic-metal compound, developed by Travaco Laboratories, 233 Condor St., East Boston, Mass., is offered in competition with other steel- and aluminum-filled epoxy resins. It is reported to have half the density of equivalent compounds, and a controlled pot life from 3 to 90 minutes.

The material is available in both liquid and non-sagging putty form. When mixed with the catalyst supplied, it is said to harden like granite in minutes. Formex #77 is said to bond tightly and permanently to all metals, plastics, wood, ceramics, and concrete.

The compound is made up of epoxy and other undisclosed resins and metallic alloys. The manufacturer states that there is no chance for the metal to settle to the bottom of the compound which is frequently a problem with steel-filled epoxies.

Expansion

St. Regis Paper Co. announces that it is more than doubling capacity at its recently acquired subsidiary, **Chester Packaging Products Corp.**, Yonkers, N. Y., and its affiliates, **Cheslam Corp.** and **Chesflex Corp.** These companies produce polyethylene film used in packaging; laminate and coat polyethylene to base materials such as cellophane, foil, and paper; and manufacture extruded polyethylene pipe. New equipment and expanded operations will be housed in a new building being constructed adjacent to the present plant. Production is expected to begin in late summer. Research facilities are also being expanded.

Monsanto Chemical Co.'s Plastics Div., Springfield, Mass., now operating new facilities which more than double the company's capacity to produce vinyl chloride polymers and copolymers.

The firm also announces that its production capacity of cyclic urea resins for textile finishing has been doubled with the completion of new production facilities now operating at the Everett, Mass., plant.

Offered to the textile industry under the tradename Resloom E-50, cyclic urea is used extensively

(*To page* 446)

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ADHESIVES	Shear Strengths up to 2500 PSI at 250° F. Write for Bulletin EP-56-94
COATINGS	Exceptional Acid, Alkali and Solvent Resistance. Write for Bulletin EP-56-8
ELECTRICAL RESINS	Potting, Encapsulation, Impregnation. High volume-resistivity at high temperatures. Write for Bulletin EP-55-73-1

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Now we're producing

MILLIONS OF POUNDS

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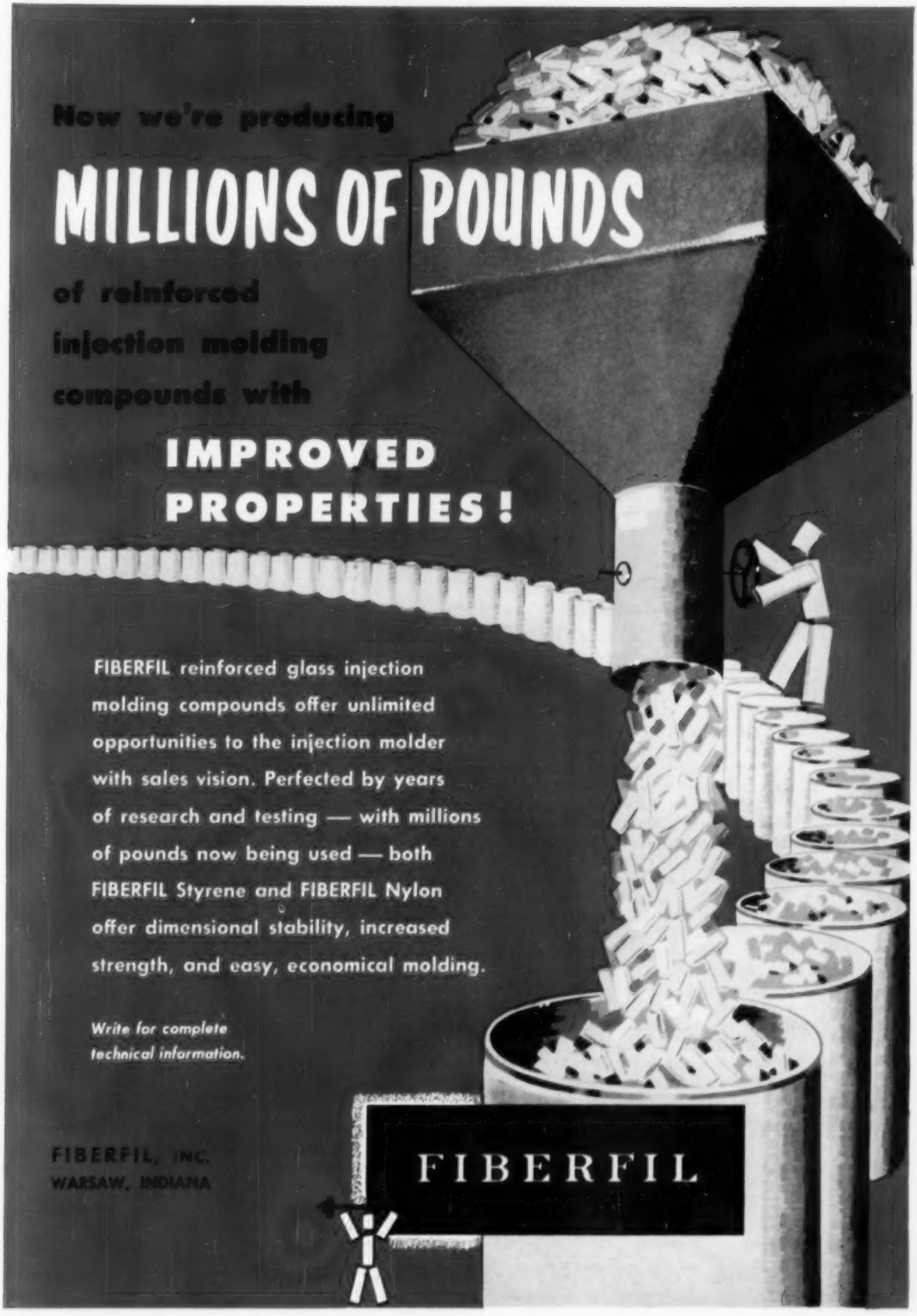
IMPROVED PROPERTIES!



FIBERFIL reinforced glass injection molding compounds offer unlimited opportunities to the injection molder with sales vision. Perfected by years of research and testing — with millions of pounds now being used — both FIBERFIL Styrene and FIBERFIL Nylon offer dimensional stability, increased strength, and easy, economical molding.

Write for complete technical information.

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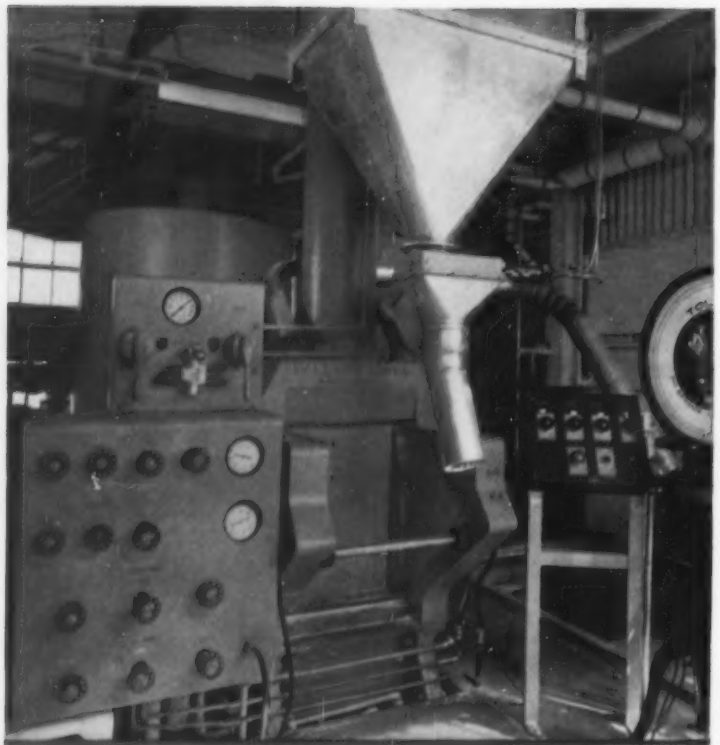

Operating platform of size 3A Banbury mixer installed over sheeting mill.

⇦ where efficient processing starts

When the Banbury® mixer is the first unit in a processing setup, the efficiency of an entire production line is dependent on the choice of Banbury capacity, special design features, installation arrangement, and control devices.

Banbury mixers are made in a wide range of sizes from the size B for laboratory work to large production sizes. This means that a machine of the proper hourly output can be chosen to match the capacity of other units in the line.

Design improvements have made the production of successive batches more and more uniform. Control equipment, such as timing device, temperature recorder and discharge mechanism, facilitate automatic control of each operation in the mixing procedure. The operation of the entire line can be controlled from a central panel to cut manual aid and supervision to a minimum.

Details of the latest Banbury developments are contained in Bulletin No. 198. A copy will be sent on request, without obligation.

FARREL-BIRMINGHAM COMPANY, INC.
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Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
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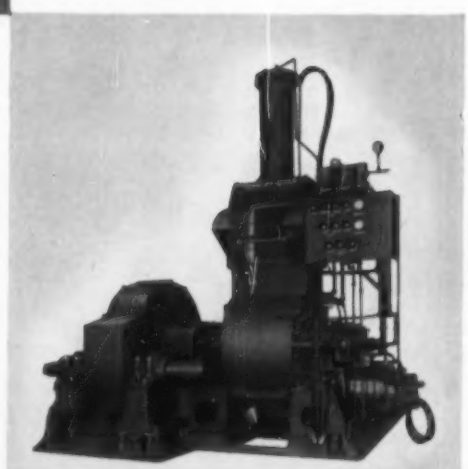

Size 11 plastics Banbury with closed circulating system and special piping for heating or cooling the machine.

F-B PRODUCTION UNITS — Banbury Mixers, roll mills, calenders, extruders, plasticators, hydraulic presses and other equipment.

Watson-Stillman plastics injection, compression and transfer molding machines.

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Ladies and Gentlemen!

Come right in and see plastics in action!

See SUPER DYLAN* polyethylene take brutal punishment and come out alive.

See DYLAN* polyethylene twisted and stretched.

See what happens when DYLITE* expandable polystyrene is subjected to cr-r-rushing weight.

And thrill to beautiful DYLENE* polystyrene in a rainbow of colors.

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The Plastiscope

to produce crush resistance, dimensional stability, and durable textured effects in cotton, rayon, and synthetic fabrics.

The Kendall Co. will erect a million-dollar plant on a 76-acre site in Franklin, Ky., for the manufacture of its Polyken pressure-sensitive industrial tape and plastic protective tape coatings for prevention of corrosion on metal pipes. The initial unit will provide 35,000 sq. ft. of floor space, more than tripling present production capacity.

Hurlbut Paper Co., South Lee, Mass., is completing plans for an expansion program involving construction of a new $3.5 million paper mill. The plant is expected to start operation by the end of 1957 or early 1958. Some of the papers to be produced at the new mill will be based on nylon, Dacron, Dynel, and other synthetic fibers. (See "Plastic 'paper'," MODERN PLASTICS 33, 246, May 1956).

American Plastics Corp., 342 Madison Ave., New York, N. Y., following a 100% expansion of facilities at its Bainbridge, N. Y., plant over the past eight months, is planning to expand its plant area and production facilities an additional 50 percent.

The company custom molds parts for industrial end uses, specializes in molding multiple-shot keys, bars, and knobs for typewriters, adding machines, test equipment, and the like. American Plastics also produces reinforced polyester resin moldings and is equipped for extruding and vacuum forming.

Claremont Pigment Dispersion Corp., manufacturer of dispersed colors for vinyl, polyester, and epoxy resins, has started full-scale production in its new plant at 39 Powerhouse Rd., Roslyn Heights, N. Y. Newly installed equipment is reported to double former production capacity. Concurrently with the opening of the new plant, Claremont has added color granules for use in polyethylene processing to its established lines.

The Borden Co. has increased the Philadelphia, Pa., facilities of its Chemical Div.'s Durite Products Dept., to approximately double present warehouse capacity. The department manufactures phenolic resins and molding material.

Hooker Electrochemical Co., Niagara Falls, N. Y., plans to build a three-story addition to its Durez plant at North Tonawanda, N. Y., for use as a product application laboratory. The new extension, which will cost approximately $300,000, will be adjacent to the present control laboratory.

Commercial Plastics & Supply Corp., 630 Broadway, New York, N. Y., national distributor of plastic sheets, rods, tubes, films, and strips, announces the completion

ASBESTOS FOR MOLDING COMPOUNDS

Here's what you've been looking for! An Asbestos fiber that possesses these amazing properties: Powminco Asbestos is practically inert. It is not affected by as much as four hours boiling in concentrated hydrochloric acid. This gives it a distinct advantage over ordinary chrysotile fiber when used in molding compounds that require an acid catalyst (phenolics, for example) and in casting resins. Possesses high absorption properties, in addition to having extremely low content of magnetic iron and very high dielectric strength.

Powminco Asbestos is recommended by many prominent plastic firms where an inert fiber, possessing unusually low shrinkage is desired.

The production of Powminco Asbestos from mine to finished fiber, and every processing operation is performed under strict quality control.

Working samples, without charge or obligation will be gladly supplied. Write to us on your letterhead.

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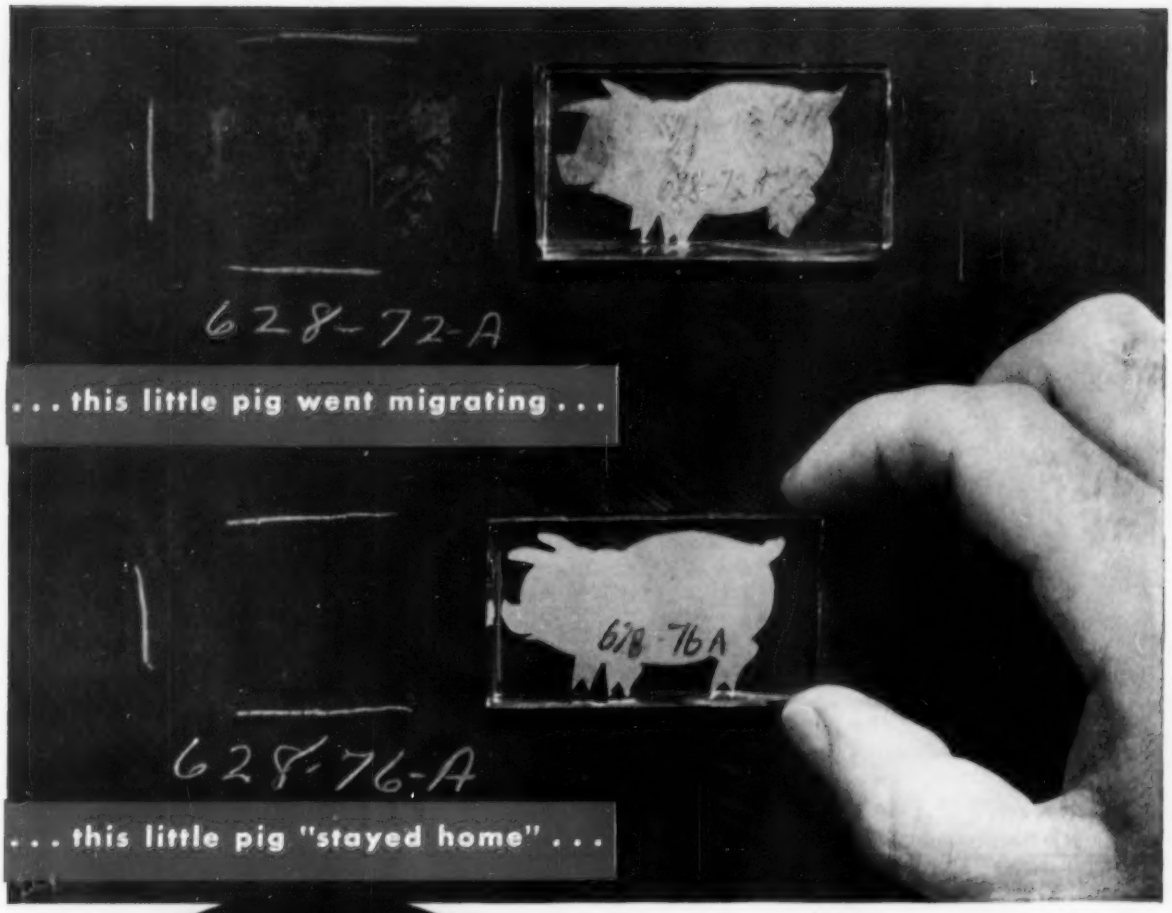

New Admex 760 POLYMERIC VINYL PLASTICIZER for True Vinyl Permanence

The two vinyl pigs shown above demonstrate the ultimate in non-migration of a vinyl film. Of course the non-migrating pig at the bottom contains Admex 760 . . . ADM's new high-viscosity polymeric vinyl plasticizer. The other contains DOP. Each is the sole plasticizer.

Both pigs were pressed against a panel finished with nitro-cellulose lacquer . . . for the same length of time . . . under the same pressure. The superiority of Admex 760 was obvious. While the film containing DOP migrated, the one containing Admex 760 the new polymeric plasticizer "stayed home".

In addition to excellent lacquer non-migration, Admex 760 exhibits unequalled resistance to migration into polystyrene, polyethylene, rubber and adhesive masses. Its resistance to solvent extraction is exceptional. It has outstandingly low volatility —and the price is pleasing too.

For technical information and evaluation samples of Admex 760, or for information on all of the ADM polymeric and epoxy plasticizers, mail the coupon today.

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OTHER ADM PRODUCTS: Linseed, Soybean and Marine Oils, Paint Vehicles, Synthetic and Natural Resins, Polyesters, Fatty Acids and Alcohols, Hydrogenated Glycerides, Sperm Oil, Foundry Binders, Industrial Cereals, Vegetable Proteins, Wheat Flour, Dehydrated Alfalfa, Livestock and Poultry Feeds.

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Yes, please send free information on Admex 760, the new polymeric vinyl plasticizer.

- ☐ Technical Data Admex 760
- ☐ Evaluation Sample Admex 760
- ☐ Bulletin 101-C on ADM Admex epoxy plasticizers.

Name_____

Firm_____

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City_____ Zone____ State_____

The Plastiscope

of its new warehouse and office at 119 19th St., Pittsburgh, Pa. The unit will carry a complete stock of Plexiglas, Lucite, nylon, Teflon, Vinylite, polyethylene, polystyrene, and Panelyte laminates.

Gus Metz will manage the new Pittsburgh warehouse and office. The firm maintains additional warehouses in New York City and Miami, Fla.

Bigelow Fiber Glass Products, a Div. of Bigelow-Sanford Carpet Co., Inc. is doubling its manufacturing facilities at the Amsterdam, N. Y., plant for the production of Rovcloth, woven glass roving used as a plastics reinforcing material.

Emerson & Cuming, Inc., 869 Washington St., Canton, Mass., has added 15,000 sq. ft. of manufacturing space to double its capacity for the manufacture of casting resins, reinforced plastics, and other plastics products for the electronics industry.

Canadian Titanium Pigments, Ltd., a subsidiary of **National Lead Co.**, has started construction of Canada's first titanium pigment plant on a 76-acre tract at Varennes, Que., about 15 miles northeast of Montreal. The facility will cost $15 million and its entire output will go to Canadian industry. Production is expected to begin in 1957.

Ace Plastic Co., 91-60 Van Wyck Expressway, Jamaica, N. Y., extruder and fabricator, is adding 25,000 sq. ft. of space to its Extrusion Dept., bringing the firm's total area to 75,000 sq. feet.

Meetings

Plastics groups

June 11-15: Seventh National Plastics Exposition, sponsored by The Society of the Plastics Industry, Inc., New Coliseum, New York, N. Y.

June 11-15: The Society of the Plastics Industry, Inc., Annual Meeting and Conference, Commodore Hotel, New York, N. Y.

June 26: The Society of the Plastics Industry, Inc., Plastic Structures Division Conference, Hotel Roosevelt, New York, N. Y.

Other meetings

June 25-29: Orkin Expositions Management, International Housewares Show, New Coliseum, New York, N. Y.

July 10-12: Sixth Western Packaging and Materials Handling Exposition, Pan Pacific Auditorium, Los Angeles, Calif.

August 26-30: National Association of Furniture Manufacturers, Supply, Equipment, and Fabric Fair and Convention, Conrad Hilton Hotel, Chicago, Ill.

September 9-12: American Institute of Chemical Engineers, Meeting, William Penn Hotel, Pittsburgh, Pa.

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CONTAINS TECHNICAL AND DESIGN DATA

R/M Bulletin No. T-55 and supplemental Technical Data Sheets present useful fundamental information for high and low pressure laminators. The data presented should suggest new uses and markets to you for scientifically engineered plastic products.

EXAMPLE

It describes, for example, Novabestos Cushioned Glass Fiber Warp, recommended for such applications as rocket launchers and Jato. You learn that this is an evenly spaced warp of 150's glass yarn sandwiched between 4 mil thick cushion layers of asbestos fiber paper—and fully bonded with B stage polyester or epoxy resin. Flexible, tough and slightly tacky, it can be easily and safely handled as a sheet or tape. Its crosswise stretch allows curvature conformation. When laminated at 15-50 psi, a highly directional solid reinforced structure of unusual properties is obtained: tensile strength, 70,000 to 90,000 psi; tensile modulus, 4 to 5 x 100 psi; flexural strength, 90,000 to 110,000 psi; columnar compression, 50,000 to 60,000 psi.

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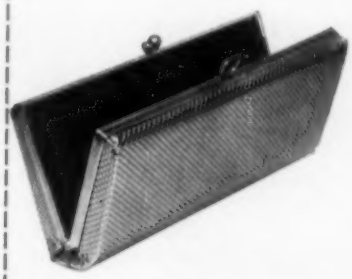
Mirro-Brite Mylar*
Applications For Accessories

Vacuum Formed Mirro-Brite
Butyrate Product Displays



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For Handbag Field

Rigid Record Album
with Silk Screened Mirro-Brite
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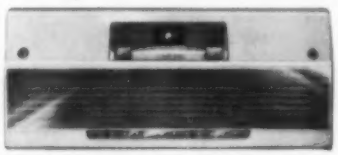
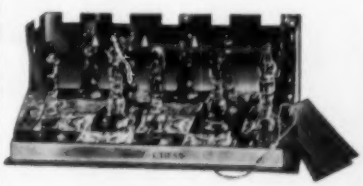


Refrigerator Panel
Silk Screened on
Mirro-Brite Polystyrene

Toy and Premium Give-Away
Using Mirro-Brite Polystyrene

Vacuum Formed Showroom
Display Sign of Mirro-Brite
Butyrate



Set-Up Package with
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New products using MIRRO-BRITE include major appliances such as refrigerators, stoves, radios, television sets; toys and novelties; point-of-sales signs and three-dimensional displays; juke boxes; set-up boxes; greeting cards.

MIRRO-BRITE metalized acetate, butyrate, polystyrene and Mylar can be vacuum formed, embossed, die-cut, laminated, silk screened and processed in countless ways. MIRRO-BRITE is available in continuous rolls and cut-to-size sheets.

Send for illustrated sampler, color chart and price list or talk to your suppliers about MIRRO-BRITE metalized plastics.

**"Mylar" is DuPont's registered trademark for its brand of polyester film.*

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Company Notes

Koppers Co., Inc., Chemical Div.: **John W. Pool, Jr.** new manager of the Sales Dept., succeeds **Carl H. Pottenger,** now vice president and assistant general manager; **B. R. Sarchet** promoted to manager of the Development Dept., replacing **Frank B. Varga,** now a vice president of the newly established **Koppers International, C.A.; H. D. Cooper,** former manager of Eastern District Sales in New York City, promoted to assistant manager of the Sales Dept.; **R. F. Seubert,** former supervisor of the sales office, succeeds Mr. Cooper.

Monsanto Chemical Co.: Domestic Subsidiaries and Affiliates Div. has been formed to administer the company's interests in **Shawinigan Resins Corp., The Chemstrand Corp., Mobay Chemical Co.,** and other affiliated companies. Vice President **J. Russell Wilson,** former general manager of the Research and Engineering Div., is now general manager of the new division, as well as director of the company's Patent Dept. **Howard K. Nason,** formerly director of research and development of the Organic Chemicals Div., succeeds Mr. Wilson as general manager of the Research and Engineering Div. **Edmund Greene** succeeds **Shea Smith III** as director of marketing research; Mr. Smith is now assistant to the president, replacing Philip A. Singleton who has resigned.

The Goodyear Tire & Rubber Co., Inc.: J. S. Bruskin, sales manager of the Films and Flooring Div. since 1955, now general manager of the division. **William T. Smith** assigned to the New York office of the Chemical Div. as sales representative, will handle primarily sales to manufacturers in the coatings field.

American Cyanamid Co.: Dr. Richard O. Roblin, Jr. and **Dr. Robert P. Parker** named assistant general managers of the Pigments and Research Divs., respectively.

Allied Chemical & Dye Corp.: Barrett Div.: Thomas P. McGuinness is now supervisor of engineering, Chemical Products; **Gerald J. Bayern,** formerly with Foster D. Snell, Inc., has joined Barrett as marketing and economic analyst.

National Aniline Div.: John J. Reed now product manager of isocyanates, **M. S. Rhodes** product manager of resin chemicals.

Arthur D. Little, Inc., Cambridge, Mass., industrial research consulting company, has acquired **The Miner Laboratories,** Chicago, Ill., chemical consultants. **John R. Kirkpatrick** will manage the new ADL midwest division, Miner Laboratories. **Dr. C. S. Miller, Jr.**

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ACCURATELY
MEASURE
EXTRUDER MELT
TEMPERATURES.
Thermo Electric "Plastic Melt" iron-constantan thermocouples can be fitted easily on an extruder head, die adapter or manifold, and inserted directly into the melt. Accurate melt temperature is maintained by using these thermocouples to set the temperature control system. They are easily removed when not in use, and can be replaced with blank bolts.
These ⅛" dia., stainless steel protected thermocouples are available in three immersion lengths: 1" (illustrated), ½", and flush. The steel bolts are ½", 20 NF, hex head. The ends are machined to seat flush inside extruder and to provide leak-proof joints.
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Thermo Electric Co. Inc.
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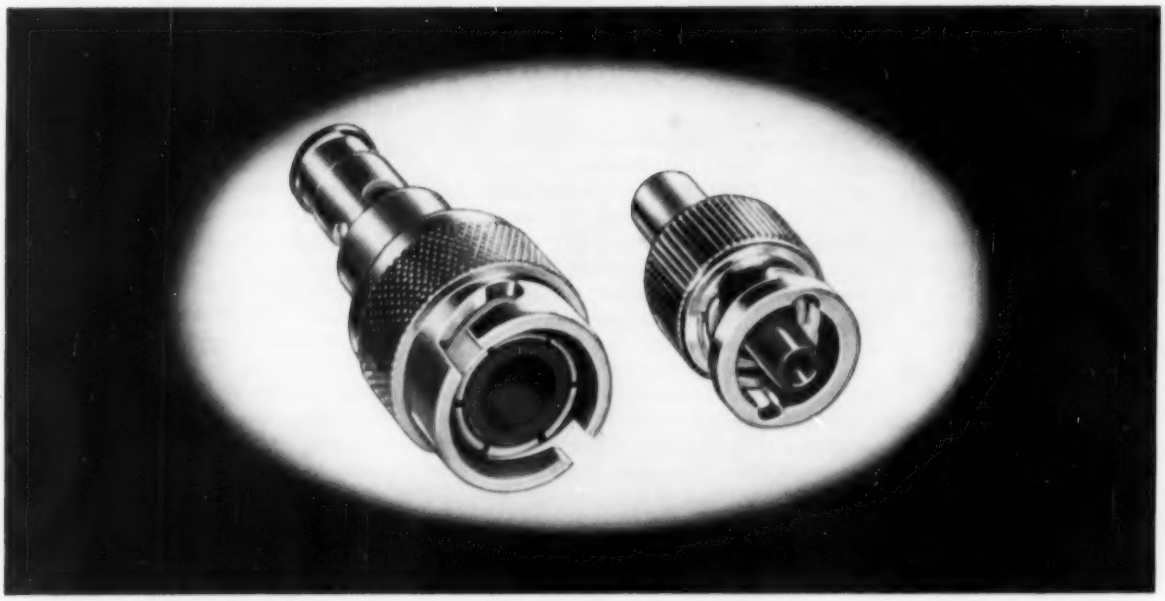

PRECISION CONNECTORS with KEL-F plastic parts have high RF insulation and dimensional stability. Plastic's high impact and compressive strength permit rough handling without chipping, cracking, or deforming. Zero moisture absorption and anti-adhesive surface prevent formation of conductive residue.

KEL-F® FLUOROCARBON PLASTIC

permits components to operate over a wider temperature range . . . under highly humid and corrosive atmospheres

KEL-F plastic's unique combination of properties can help your product meet more rigid performance specifications. Because of the extreme stability of the fluorocarbon plastic molecule, this dense, tough thermoplastic has superior dielectric properties, excellent resistance to corrosive chemicals, outstanding thermal and dimensional stability, and zero moisture absorption.

Molded and extruded parts operate over an extremely wide range of temperatures (−320° F. to 390° F.) . . . are unaffected by humidity or operational vibration. Metal inserts, lugs and contacts are held firmly, forming a hermetic seal.

KEL-F plastic is available from Kellogg as a molding material, or in sheets, rods, strips, tubing, film and "spaghetti" from qualified fabricators and molders throughout the country. For further information, write: The M. W. Kellogg Company, Chemical Manufacturing Division, P. O. Box 469, Jersey City 3, N. J.

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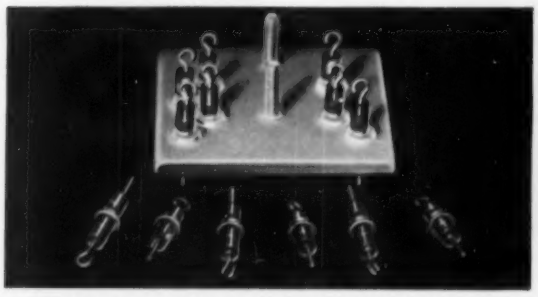
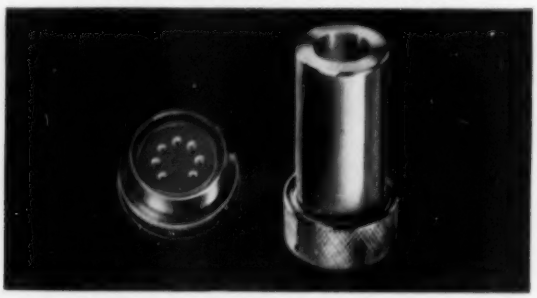


HERMETICALLY-SEALED TERMINALS with KEL-F plastic insulation handle high voltage without flash-over or tracking. Won't shrink, swell, age or lose hermetic seal at high and low operating temperatures. Can be used in contact with highly corrosive chemicals.



TUBE SOCKETS of tough KEL-F plastic. Hermetic seal defies thermal cycling, aging and humidity. Withstands high shock loads without chipping or cracking insulation. Plastic's high dielectric strength prevents shorting or arc-over at high altitudes.

Company Notes

will continue to direct its technical operations, which will supplement ADL's main Cambridge laboratories in research for clients in the midwest.

The Miner Laboratories was instrumental in the development of the process in use today for recovering furfural—an important raw material for nylon—from oat hulls and corn cobs.

The Dow Chemical Co.: R. W. Swinehart, former director of the Cellulose and Plastics Laboratory of the Plastics Production Dept., is now superintendent of cellulose products and will be responsible for the production of cellulose products and derivatives. He succeeds **Merrill H. Weymouth,** recently named manager of the Hanging Rock plant being built near Ironton, Ohio, for the production of Styrofoam. **Paul Greenfield,** former assistant of the laboratory, now director and **Malcolm Chamberlain** assistant director. **Earle L. Kropscott** promoted to staff manager of molding materials for the Plastics Dept.

The Borden Co., Chemical Div.: **Charles J. Bahun** and **Dr. K. U. Patel** to the Philadelphia, Pa., laboratory staff of the **Durite Products Dept.,** Mr. Bahun in charge of molding material development and Dr. Patel as chemical engineer on the development staff.

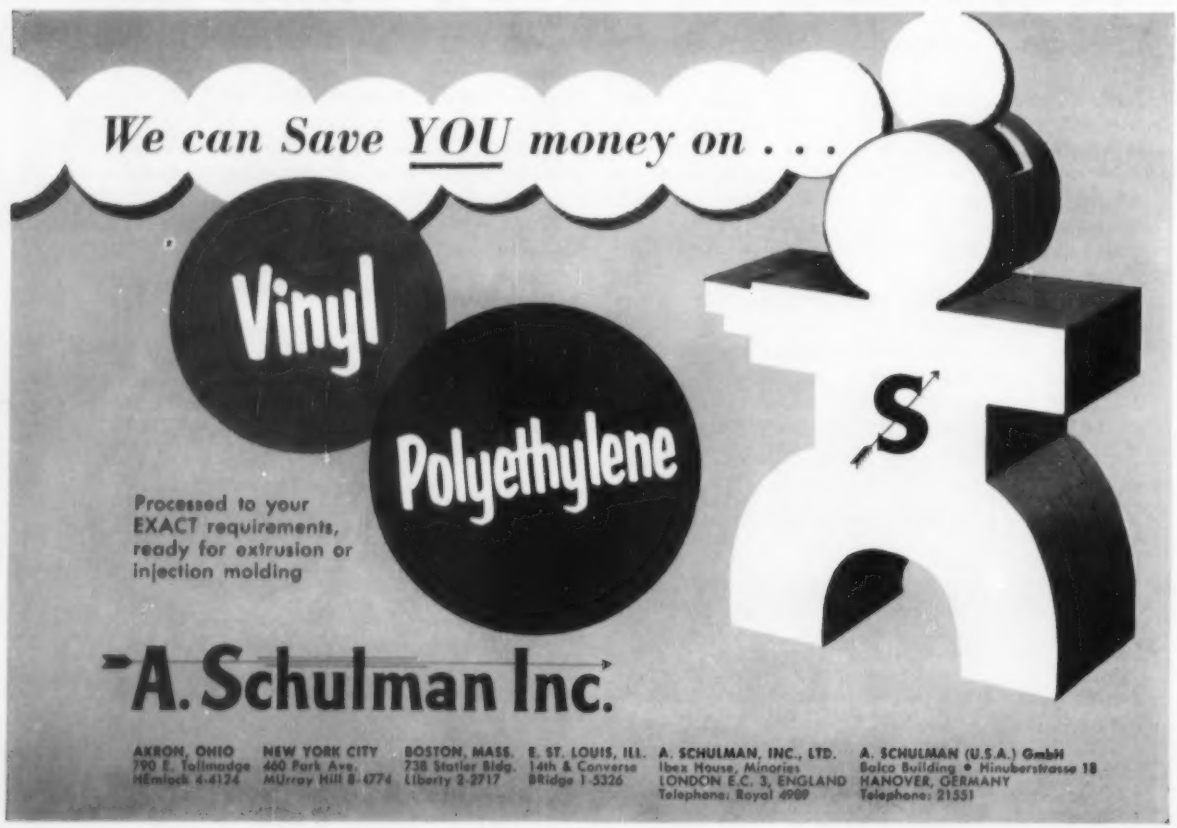
Donald A. Regnier and **Errol M. Thompson** to the technical staff of the **Resinous-Reslac Dept.** Mr. Regnier will cover Ohio and Mr. Thompson the New England area.

American Viscose Corp.: Thomas O. Williams to manager of the newly created Customer and Sales Service Dept. **Guy A. Martinelli** named sales manager of **Sylvan Plastics, Inc.,** a subsidiary of American Viscose. **Robert A. Gift, Jr.** will handle technical service problems in addition to his sales responsibilities. Sylvan Plastics sells urea molding resins produced at the parent company's Fredericksburg, Va., plant.

The Kendall Co., Polyken Sales Div.: William J. Flaherty and **John M. McGivern** assigned as market development specialists in the Merchandise Dept. working directly with **Howard D. Segool,** manager.

Celanese Corp. of America: Plastics Molders Supply, 74 South Ave., Fanwood, N. J., and **Atomik Sales Co.,** 833 W. Davis St., Dallas, Texas, have been named distributors of Marco polyester resins, catalysts, accelerators, and separating films.

Emery Industries, Inc.: Two new sales departments have been formed to replace the present single chemical sales operation: The Organic Chemical Sales Dept., headed by **Robert F. Brown** with **Robert Hull** and **Vern Colby** as assistant sales managers, will handle the sales of all non-fatty Emery products,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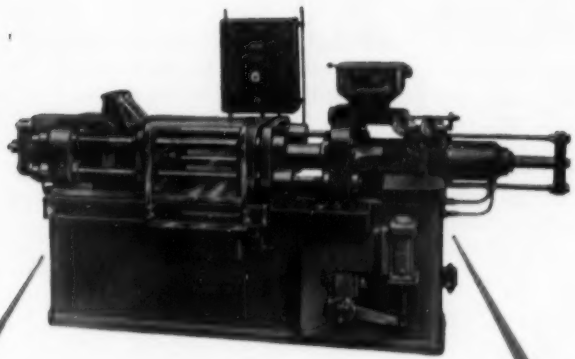
INJECTION MOULDING MACHINES

MILANO ITALY



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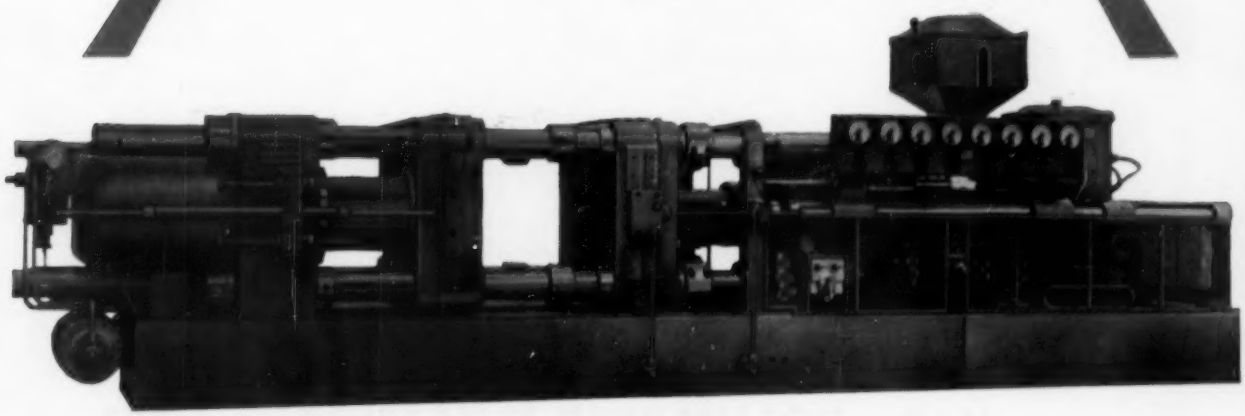
to 215 ounces



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Company Notes

including plasticizers. The Fatty Acid Sales Dept., headed by **G. William Boyd**, will handle stearic, oleic, and hydrogenated fatty acids and glycerides; derivatives of castor oil; and others.

The General Tire & Rubber Co., Respro Div.: Fred R. Messina, formerly with the **Bolta Div.**, now plant engineer of Respro. **John M. O'Grady** promoted to manager of the Production Control and Sales Order Dept.

Hercules Powder Co., Inc.: Joseph J. Coughlan and **Benjamin F. Brown** now technical sales representatives in the Cellulose Products Dept. of the Plastics Sales Div.

Society of Plastics Engineers, Inc. announces the resignation of **James Underwood** as executive secretary. Mr. Underwood returns to Washington, D. C., to resume his law studies. Applications for the position are being solicited by S.P.E. and should be submitted to the society's offices at 34 E. Putnam Ave., Greenwich, Conn.

The Fellows Gear Shaper Co.: Edward W. Miller, formerly president and general manager, now president only; **Edwin R. Fellows II**, former assistant general manager and export manager, is new vice president and general manager.

National Polychemicals, Inc.: Roy D. Perdue, Jr., formerly with Barrett Div. and The Baker Castor Oil Co., has been appointed project engineer at the Wilmington, Mass., plant and laboratory. **Joseph H. Murphy**, formerly with Esso Research and Development Co., has joined the research and development group.

Archer - Daniels - Midland Co., producer of chemicals used by the plastics industry, has opened a sales office at 2525 Cline St., Houston, Texas. **Jack Calkins** will manage the office; **John Florence** is technical sales representative for the Houston area. **John J. Foster** and **Henry E. Billiat, Jr.** are technical sales representatives for the Cleveland, Ohio, and Kansas City, Mo., areas, respectively.

Fiberfil, Inc.: John H. Keeley has been appointed sales manager and **Robert G. Duncan** plant manager. The company manufactures glass-filled nylon and polystyrene molding compounds.

Sarco Co., Inc. and its affiliate, **Sarcotherm Controls, Inc.**, manufacturers of temperature regulators, have moved their Chicago offices to larger quarters at 3209 N. Lamon Ave.

L.O.F. Glass Fibers Co.: George C. Arnold named field representative in the Boston area, to succeed **George R. Frick** promoted to district sales manager in the Syracuse area. **John M. Keenan**, former manager of the Waterville plant, now plant manager at

U. S. POLYMERIC CHEMICALS, INC. announces the opening of a new West Coast plant at 700 East Dyer Road, Santa Ana, California (Phone: Kimberley 5-4412) for the production of:

- melamine impregnated papers for decorative laminates
- melamine glass cloth and mat for electrical sheets, rods and tubes
- silicone impregnated glass cloth for low and high pressure laminates for use in the electrical and aircraft industries
- polyester impregnated glass cloth and mat for aircraft
- a wide range of epoxy impregnated glass cloth and glass mat for the electrical and aircraft industries
- high temperature phenolic resin-impregnated glass cloth and glass mat

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Box 546, Stamford, Connecticut

now. . .

completely automatic STANDARD Molding Presses

The new Hull-Standard fully-automatic Molding Presses are the product of 23 years of experience in the plastic molding industry, during which time more than 1600 Standard Presses—including nearly 200 special-duty fully-automatic models—were placed in service.

See this modern, high speed, cost cutting automatic at the Plastics Show—Booth No. 535 or write for literature.

HIGH PRODUCTION

High speed cycle (less than 12 Sec., plus cure), times large die area (18" x 18¾") means many times the production per hour.

ECONOMY

Only one operator needed for up to 10 automatic presses. Low power requirement—operates on 3 hp. motor—costs only pennies per day.

FLEXIBILITY

Quickset Cycle Control puts press cycling at your fingertips. Sensitive slow-close adjustment provides wide range of closing speeds to suit plasticizing time requirements of materials. Press may be operated as semi-automatic to try out or break in molds or for smaller or sample production.

SAFETY

Sequence safety interlock protects operator, mold and machine. Each operation must be preceded by a completely successful previous operation or the machine shuts down entirely.

. . .

HULL-STANDARD
ABINGTON, PENNA.
CORPORATION

NEW, IMPROVED

NO BUNCHING
NO TUCKING
NO PLEATING
with Duofold's H-3
IT'S FIBER-GLAS!*

a knit, elastic Fiberglas* reinforcing fabric

* OWENS CORNING FIBERGLAS

New, improved H-3 conforms itself to irregular objects with all the smoothness of skin over a bunched fist.

This Fiberglas* fabric is tubular *knitted*, thus allowing full flexibility of stretch. Its unusual elasticity makes it ideal for all plastic reinforcing jobs — airplane seats, helmets, radomes, and all unusual shaped parts. Can be heat-cleaned and chrome-finished.

If tucking and pleating is a problem in your use of conventional woven reinforcing fabrics, write us today on your business letterhead. We'll send full information and samples of New H-3 for experimental work.

Duofold, Inc. Dept. H-3 Mohawk, N. Y.

Company Notes

Parkersburg, W. Va., succeeding **Donald L. McClure** who is new director of industrial relations. **Gerald L. White**, former supervisor of the fiber-forming department, replaces Mr. Keenan.

Textileather Div., The General Tire & Rubber Co.: William D. Lippmann named administrative assistant, moving from the plant to the general offices; **William T. Siebenthal** now production manager of the plant.

Zack Industries, manufacturer of radiant heaters and vacuum forming machines, to larger quarters at 185 Goffle Rd., Hawthorne, N. J.

G. Felsenthal & Sons, Inc.: Ben W. Rau, previously executive vice president, now president and treasurer, succeeding the late **Irving G. Felsenthal**, a son of the original founder. Other new officers are: **N. C. Ratner** and **James H. Moses**, vice presidents; **James G. Felsenthal**, a grandson of the founder, corporate secretary.

Arrow Laboratories, Inc., 236 W. North Ave., Chicago, Ill., is new name of the company formerly known as **American Maintenance Supply Co.** The company manufactures Detero wax beads used in compounding P.V.C. for extrusion.

Plastic-Craft Mfg. Co. now located at 50-54 Illinois Ave., Paterson, N. J.

Ideal Plastics Corp., Div., of Ideal Toy Corp.: Lawrence Hansburg now director of purchases of both firms and **George Baron** in charge of all plastics purchases.

National Research Corp. has licensed **The Dobeckmun Co.**, Cleveland, Ohio, to conduct operations under patents relating to continuous vacuum metallizing. Dobeckmun is reported to thus gain full access to developments of National Research relating to continuous metallizing of plastics and the right to operate under present and future patents.

Bo-Mer Mfg. Co., Inc. has purchased the plant, equipment, and processes of **Corbett Specialties Co., Inc.**, 40-42 Washington St., Auburn, N. Y., and will locate at this address. The company offers molding, vacuum forming, and fabricating services.

Owens-Corning Fiberglas Corp.: Dr. A. C. Siefert now director of research and **Dr. L. P. Biefeld** technical director of the Research Div.

National Rubber Machinery Co.: F. F. Barber Machinery Co., Ltd., Plastics Machinery Div., Toronto, Ont., will handle sales and engineering service on NRM thermoplastics extruders and equipment in Canada.

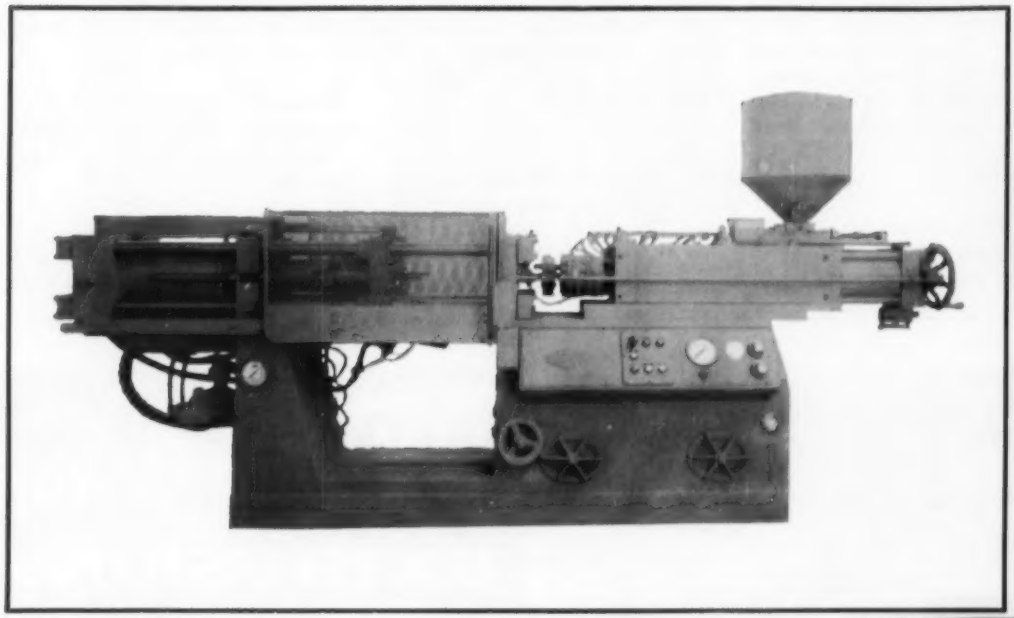
Farrel-Birmingham Co., Inc. moved its Chicago office to larger quarters at 10725 S. Western Ave.

IMPCO

P200

#1155

MODEL
HA2-125
INJECTION MOLDING MACHINE



2-3 OUNCES

This page is a reproduction of the cover of our new bulletin entitled Description and Specifications of the Impco Model HA2-125 Injection Molding Machine.

Write for a copy of this bulletin for a complete description of this versatile new machine, designed to combine high speed with high plasticizing capacity.

IMPROVED
MACHINERY INC.
NASHUA, NEW HAMPSHIRE

Personal News

William J. Canavan, new manager of **Bakelite Co.'s Extrusion Materials Div.,** will be responsible for sales to the manufacturers in the wire, cable, pipe, and related fields.

Erwin W. Brown now general manager in charge of plastics of **Irvington Varnish & Insulator Div., Minnesota Mining & Mfg. Co.**

Philip M. Dinkins, vice president of operations of **General Aniline & Film Corp.'s Dyestuff and Chemical Div.,** is now a member of the board of directors. Mr. Dinkins was formerly president and director of Jefferson Chemical Co., Inc.

Dr. W. Mayo Smith, Jr., formerly with Firestone Tire & Rubber Co., now assistant director of research of **Escambia Bay Chemical Corp.,** Cambridge, Mass., in charge of polymerization and plastics research and development.

Frank Caplan, formerly with Firestone Plastics Co., has joined **Bradley & Vrooman Co.,** Chicago, Ill., as technical sales engineer engaged in the development of new applications and sales of plastisols and organosols.

Ferd Nadherny now assistant to **Owen J. Brown, Jr.,** vice president and director of sales of **Godfrey L. Cabot, Inc.,** Boston, Mass.

Dr. Robert S. Holdsworth, formerly with the Naugatuck Chemical Div., U. S. Rubber Co., now with **National Research Corp.,** Cambridge, Mass., as a group leader in the Petrochemicals Research Dept., will be engaged in research in polymerizing.

Dr. John S. Young named automotive industry specialist for Du Pont's plastics sales section.

Leonard Becker, formerly head chemist and vice president in charge of the Plastics Div. of S. Buchsbaum & Co., to vice president in charge of extrusion and new product development of **Resincraft Plastics, Inc.,** Chicago, Ill.

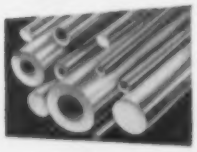
Walter Friedman appointed sales manager of the premium division of **Precision Extruders, Inc., a Div. of Lamex Chemical Corp.,** Leominster, Mass.

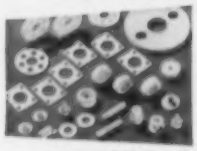
James W. Kearns, Jr. to sales manager of **Fiber Glass Products Div., Bigelow-Sanford Carpet Co., Inc.,** New York, N. Y.

Patrick V. Lepore, formerly with American Cyanamid Co., is now on the sales staff of **John H. Calo**

TEFLON* sheet . . . rod . . . tubing . . . molded or machined parts?

You can get just what you want from JOHN CRANE





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In addition, you get these important *plus* factors: complete uniformity throughout, high density control, freedom from flaws and rigid adherence to your specifications.

Request full details. Crane Packing Company, 6454 Oakton Street, Morton Grove, Illinois (Chicago Suburb). *In Canada: Crane Packing Co., Ltd., Hamilton, Ontario.*

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1. **DESIGN** Vogt engineers will carefully design the extrusion best suited to your job.
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3. **COLOR MATCHING** Our color matching experts will quickly match any color or shade with the greatest accuracy.
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5. **SAMPLES** Our sample department will rush a sample to completion for your approval.
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Whether you require tubings, rods, bindings, weltings, or special shapes, it will pay you to consult Vogt.

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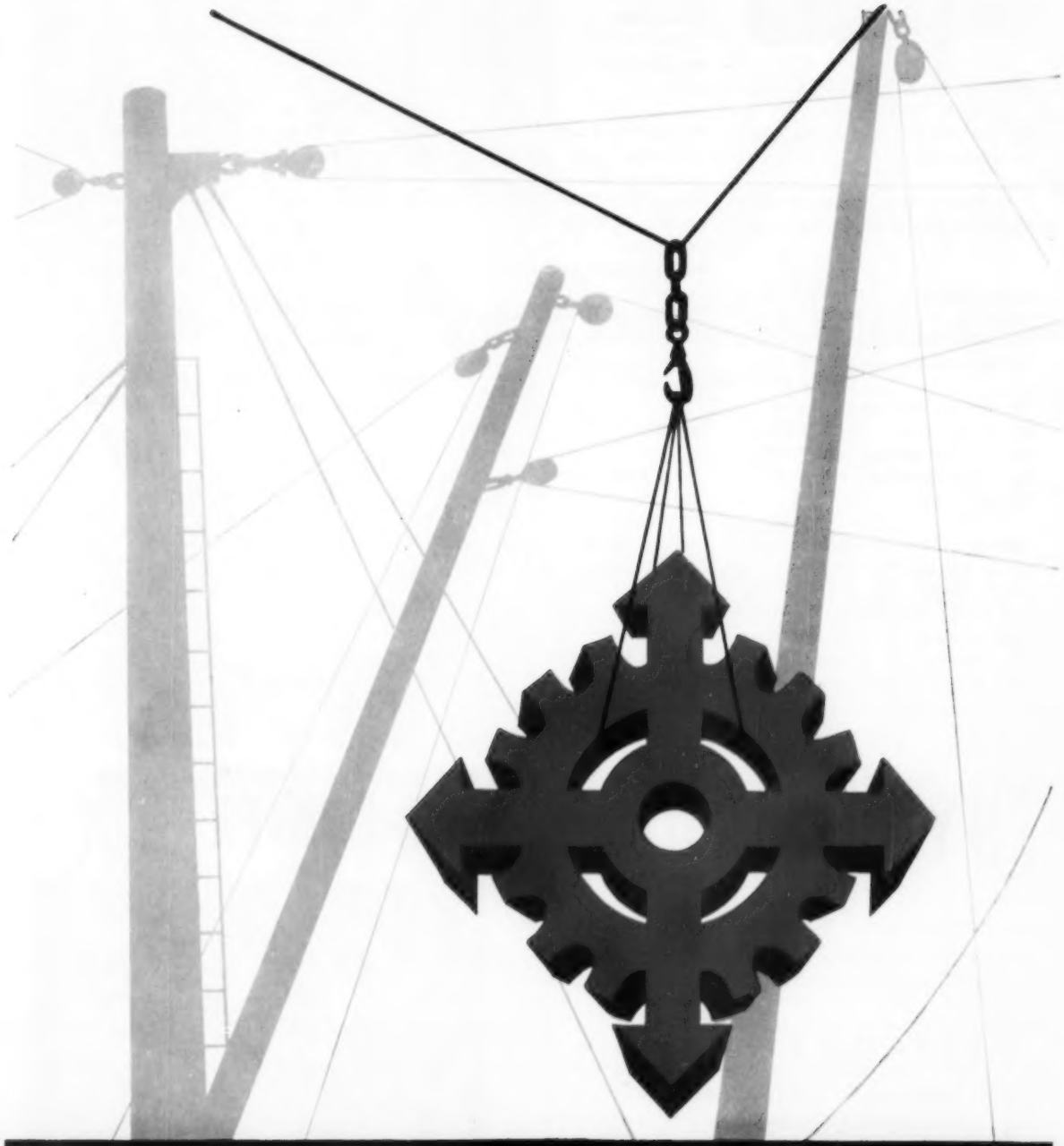

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WORLD-WIDE DISTRIBUTORS

BOOTH 432

Personal News

Co., Inc., New York, N. Y., distributor of resins, oils, etc., to the protective coatings and plastics industries.

J. D. Proctor is new general sales manager, **The Celluplastics Corp.**, Newark, N. J.

J. H. Dollinger appointed sales manager of vinyl stabilizers of **Ferro Chemical Corp.**, subsidiary of **Ferro Corp.**, Cleveland, Ohio.

Dr. George H. Argue named director of research and development of **Fabricon Products' Plastic Impregnating Div.**, River Rouge, Mich.

Francis H. Bebee is now manager of the newly created Commercial Development Dept. of **Interchemical Corp.**, New York, N. Y. The new department will investigate the commercial possibilities of new products and new fields of activity, as well as the commercialization of projects and new products to the point where they are assigned to an operating division.

George H. Clark retired as vice president and assistant to the president of **The Formica Co.**, Cincinnati, Ohio, after 30 years' service, will continue his association with the company as a consultant on engineering problems.

William J. Dewar now with **Furane Plastics, Inc.**, Los Angeles, Calif., as a product engineer responsible for development of epoxy molding and related compounds.

Dick Voelz, new sales engineer of **Hull-Standard Corp.**, will handle its semi-automatic and fully automatic molding presses in the Wisconsin, Illinois, and Indiana territory.

W. F. Twombly, vice president of **Witco Chemical Co.**, appointed consultant on organic chemicals in the Chemical and Rubber Div., Business and Defense Services Administration, Department of Commerce.

Robert R. Silverstone to **Sherwin-Williams Co.'s Industrial Sales Div.** as representative in the western industrial zone. He will specialize in the insulating compound field, including insulating varnishes, wire enamels, printed circuits, and associated products.

Edward Buck, formerly with Package Machinery Corp., now machine service engineer of **Olin Mathieson Chemical Corp's Film Div.**, New York, N. Y.

Correction

The May issue of The Plastiscope reported that **Francis V. Duffy** had been appointed director of the Petrochemical Div., **Foster Grant Co., Inc.**, Leominster, Mass. The announcement should have stated that he was named director of sales research of the Petrochemical Div.

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Prompt delivery on extruded nylon rod in a full range of sizes and close tolerances to meet your specifications.

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Rods, tubes, profiles in acrylic and all other thermoplastic materials.

Blown film and bags in polyethylene.

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DAPON® resin

the NEW diallyl phthalate prepolymer

DAPON resin—a free flowing powder, *easy to handle, easy to store*—retaining all the excellent cured properties of diallyl phthalate.

NOW articles can be made from diallyl phthalate, in the form of DAPON resin, which could not be made by direct polymerization of the monomer.

Molding compounds, impregnated textiles, resin blends containing DAPON resin have important applications. Products such as *decorative laminates; molded parts* for service under high humidity or corrosive conditions; *low pressure laminates* for structural or high frequency work are now being made with DAPON resin. In these applications the absence of volatiles, low shrinkage, excellent physical and electrical properties make DAPON resin the ideal choice.

DAPON resin is now commercially available.

For technical literature listing physical data, suggested uses and methods of handling write:

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Food Machinery and Chemical Corporation
Nitro, West Virginia
Department 28

FMC CHEMICALS INCLUDE: WESTVACO *Alkalis, Chlorinated Chemicals and Carbon Bisulfide* • BECCO *Peroxygen Chemicals* • NIAGARA *Insecticides, Fungicides and Industrial Sulphur* • OHIO-APEX *Plasticizers and Chemicals* FAIRFIELD *Pesticide Compounds and Organic Chemicals* • WESTVACO *Phosphates, Barium and Magnesium Chemicals*

These clock faces give the appearance of costly metals. Actually, they are inexpensive plastic coated with aluminum under high vacuum. This covers the parts with a soft silvery finish, or . . . after a simple lacquering operation, the finish of burnished copper. Other lacquers provide a rainbow of colors to brighten your products and sales picture. The whole process is easy and economical.

"Vacuum metallizing gives us a much wider market for our molded plastics and additional profit for the operations performed after molding."

W. C. Conroy, Sales Manager
Plastics Division Erie Resistor Corporation

Erie Resistor Corporation, Erie, Pa., uses a battery of *CVC* vacuum coaters to give inexpensive plastic parts the rich finish of costly metals.

Coating parts with aluminum under high vacuum and applying various lacquers can give them the attractive appearance of gold, silver, copper, or a whole rainbow of other metallic colors.

The two clock faces shown above, for example, have the soft sheen of burnished copper and silver. Stringent tests (see below) show that the metallized finish is durable. Rough usage leaves its color and shine unmarred.

Vacuum metallizing is simple and inexpensive. A few hours training makes any of your help expert in the metallizing operation. Just a few ounces of aluminum covers thousands of parts. The process works as well with basic metals as with plastics.

You are welcome to share our experience in high-vacuum metallizing and associated lacquering operations.

We will be glad to discuss any particular applications with you.

Tests used by Erie Resistor on the metallized finish of the clock faces:

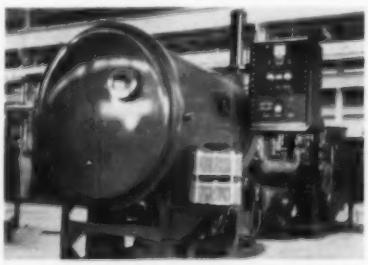
Scratch test. Cut cross-hatched lines approximately $\frac{1}{16}$" apart with sharp tool. Stick clear adhesive tape over the surface. When tape is removed, finish should remain on part.

Temperature shock. Place parts in 140° F. oven for two hours. Remove and place immediately in −20° F. cold chamber (air).

Humidity test. Expose parts to 120° F. for two hours and then to 92% R.H. at room temperature (86° F.). Four cycles of this exposure.

Fading test. Expose samples to ultraviolet light for 100 hours using a Corning 5" DCVX RDL-type filter with a G.E. 1000-watt, RH-4 mercury vapor lamp located 7" from the samples. No fading or discoloration should occur.

The above tests should not cause any observable change in the finished parts.



This 48" vacuum coater is one of three CVC production coaters used by Erie Resistor. Smaller sized models also available from CVC provide economical operation for short production runs. We deliver these units with all necessary equipment and controls—ready to install.

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8 inch plastic extruder

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- ★ VARIABLE SPEED DRIVE
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- ★ SCREW SPEED INDICATOR
- ★ 8" DIA SCREW—VARIOUS DESIGNS FOR SPECIAL PURPOSES
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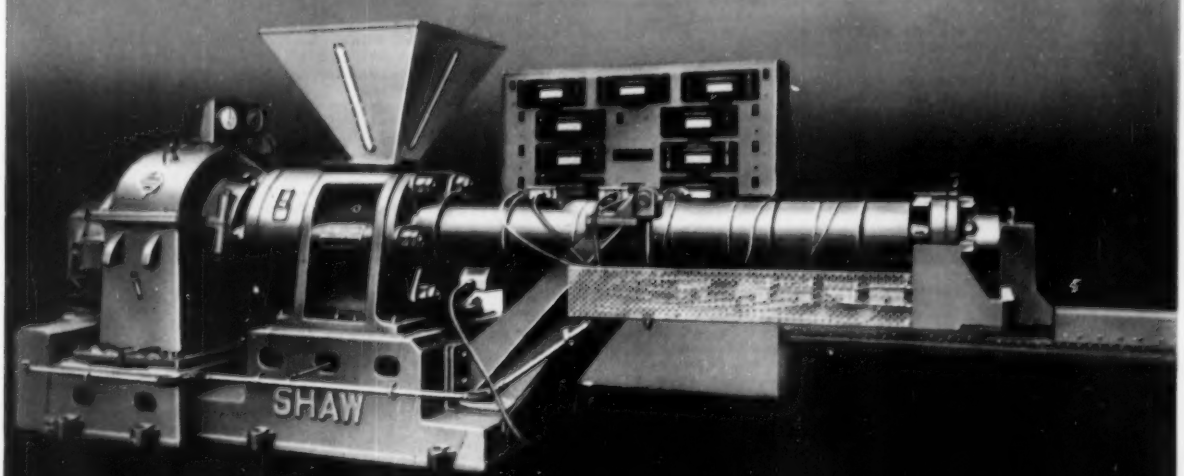
- ★ SEPARATELY CONTROLLED HEATING ZONES
- ★ HOPPER TEMPERATURE INDICATION
- ★ WATER COOLING OF SCREW AND FEEDBOX
- ★ DIE-HEAD FOR SHEETING (AS ILLUSTRATED) OTHER TYPES OF DIE-HEADS AVAILABLE

Once again, Shaw, the leaders in plastics machinery, introduce a machine of outstanding importance. Among the special features are:—Variable speed drive through reduction gear unit designed to eliminate noise and vibration; screw with metering section at delivery end, designed for efficient water cooling and removable from die end of barrel; central hopper arranged for water cooling; cylinder of hardened alloy steel with temperature range 0-400°C; four separate heating zones with die-head and die-tip heaters separately controlled; speed range 8-80 r.p.m.



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NEW ARRIVALS FOR SALE: French Oil Mill Mchy. Compression Molding Presses; 75-170 tons, 3-170 tons, 35"x18", 5-95 tons 29"x18", 3-75 tons 18"x17", 5 Preheaters 2 KW, Wood 20"x20" 12" ram 170 tons; Southwark 24"x24" 12" ram, 170 tons; Baldwin Southwark 4-26"x26" 8" rams, 75 tons; 5-26"x26" 7" rams 57.7 tons; 2-15"x15" 8" rams 75 tons; 2-19"x24" 10" rams, 78 tons; 2-12"x12" 7½" rams 66 tons; 2-D&B 12"x12" 7" rams, 57.7 tons; 8"x9" 4½" rams, 24 tons; D&B 12"x12" 3" rams, 10 tons; HPM Transfer Molding 75 tons; Preform Presses, Colton 5½T Stokes R and DDS-2 MD; New Universal Dual Pumping Units 3-15 HP; Laboratory Mills and Calenders; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. Universal Hydraulic Machinery Co. Inc., 285 Hudson Street, New York 13.

FOR SALE: 1—37x37"—10 opening hydraulic press, 30" ram; 4—20x20" hydraulic presses, 15" ram; 1 R.D. Wood 30 ton self-contained lab press; 4—10-20 ton lab presses with hand pumps; 9—Cumberland #½ grinders, 5 HP; also extruders, mixers, mills, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N. Y.

FOR SALE: 1—Royle #4 Extruder, motor driven; 1—6"x12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size O m.d.; 2—Baker-Perkins Size 15, 100 gal. Jacketed Mixers; 5—Horizontal Dry Powder ribbon Mixers, 4000#, 1500#, 500#; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Farrel-Birmingham 60" Mill with reduction drive, 150 HP motor, floor level mounting; 1—Fitzpatrick "D" Comminutor, S.S. contact parts, jacketed; 1—Mikro Pulverizer #2th, with motor; 4—Reed-Prentice & W-S Injection Molding Machines, 2-16 oz.; Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? Consolidated Products Co., Inc., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425, N.Y. Tel.: BArclay 7-0600.

FOR SALE: 3—Ball & Jewell #2, #1½ Rotary Cutters; 1—Cumberland #0 Rotary Cutter; 4—Two Roll Mills 20"x22"x60", 15"x40", 6"x14"; 3—Baker Perkins 100 gal., 50 gal., 2 gal., jacketed double arm Mixers; 1—Stokes Rotary Preform Press #DD52; 3—Stokes Model "R" single punch Preform Presses; 1—Kux Model 15-25 Rotary Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

AVAILABLE AT BARGAIN PRICES. W.&P. 200 gal. Jacketed Mixer with sigma blades, tilting type bowl. Baker Perkins 200 gal. Double Arm Mixer with sigma jacketed blades, can be used with and without vacuum dome. J. H. Day from ¾ up to 100 gal., Imperial and Cincinnatus D. A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Gemco 2000 lbs. 56 cu. ft. Double Cone Blender. Mikro Bantam, 1SH, 1F, 2TH Pulverizers. Day, Rotex, Tyler Hum-mer, Robinson, Raymond, Gayco, Great Western Sifters. Colton 2RP and 3RP Rotary Tablet Machines. Carver Laboratory 20 ton hydraulic Press. Package Machy. FA, FA2, FA4, Miller, Hayssen, Wrap-King, Scandia, Hudson Sharp, Oliver Auto. Wrappers—all sizes. This is only a partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements.
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New York 12, N. Y.

FOR SALE: Stainless Steel Rotary Dryer. Link Belt Co., 5'2"x16". No. 502-16, with all auxiliary equipment. Roto louvre also 6'x24' and 5'x26'. Hersey Stainless Steel Rotary Driers. Reply Box 9033, Modern Plastics.

FOR SALE: (11) 75 ton record presses, complete ● $2,450, (11) new 100 ton, 10" ram, 10" stroke ● $1,100, (8) 200 ton, 9" stroke, 14" ram, 36x36 ● $1,850, (7) 200 ton, 9" stroke, 15" ram, 30x30 ● $1,650, (1) 50 ton complete, 18x18 ● $1,850, (1) 200 ton, 16" ram, 30x30 ● $2,450, (2) 200 ton, 16" ram, 42x42 ● $2,850, (1) 200 ton, 15" ram, 42x42 ● $2,450, (4) 250 ton, (2) 12" rams, 30x60 rebuilt ● $3,375. Hydraulic Sal-Press Co., Inc., 388 Warren Street, B'klyn, N. Y.

FOR SALE: (2) 300 Ton W.S. Presses 20x 20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen. Standard Mystic Embossing Presses, Accumulators, Pumps, Valves. 250 Ton W&S 28x24 Platens, 80 Ton Farrel 24x24 Platens. Many other Presses—Send for Bulletin. Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N.Y. Tel.: WAlker 5-8300.

FOR SALE: 60 oz. H.P.M. w/1200 ton clamp; 48 oz. Lester; 48 oz. DeMattia; 32 oz. Lester, 1950, $22,000; 32 oz. R-P, 1950, $26,000; 40 oz. H.P.M., 1949, $27,000; 16 oz. R-P, 1948, $13,000; 16 oz. Impco, w/10 oz. cyl., $7,500; 16 oz. H.P.M. 1951, $15,000; 16 oz. H.P.M. 1946, $8,000; 12 oz. DeMattia w/16 oz. prepack, fully hyd., 1951/52, $10,000; 12 oz. DeMattia, $7,000, Terms; several 12 oz. Lesters; 8 oz. Reed-Prentice 1952, $9,500; 8 oz. R-P, single link, $3,750; 8 oz. Leominster, $3,750; 9 oz. H.P.M. 1946, $5,000; 9 oz. Monson, $5,500; 6 oz. R-P, $7,000; 8 oz. Reed-Prentice, rebuilt, $7,000; 4 oz. Lester, $3,000; 4 oz. Lester, fully aut., 1953, $8,500; 4 oz. Lester vert., $5,000; 4 oz. Watson-Stillman, $4,000; 4 oz. H.P.M., 1948, $4,500; 4 oz. Impco; 3 oz. Fellows, 1953, $8,000; 3 oz. Fellows 1951, $5,500; 2 oz. semi-aut. Van Dorn, lever type, $2,000; 2 oz. Moslos, 1954; Stokes presses, all types; DeMattias, horiz. & vert.; Italian extruders, granulators, Ovens. Let us list your surplus equipment. Acme Machinery & Mfg. Co., 102 Grove St., Worcester, Mass.

FOR SALE: Lester Injection Molding Machines 4, 8, 12 and 16 oz.—W-S and Baldwin Hobbing Presses 150 to 2000 ton—Bolling Laboratory Presses 50 to 150 ton—Molding Presses and Pumps—new ¾" Hi-Speed Hydraulic 3000 psi Double Solenoid Hydraulic Control Valves—partial listing—we buy used plastic molding equipment. New 6"x12" M.P. Laboratory Mills. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N. J. Telephone DE 4-1615; Cable address "Plasmex-Boonton."

FOR SALE: Marco Process consisting of: Homogenizer, Roto-Feed Mixers, Reactors, Kom-Bi-Nators, Pumps, all stainless steel. Heavy Duty Double Arm Sigma Blade Mixers. (2) Readco 50 gal. 30 HP; (2) W&P 100 gal.; (2) J. H. Day 75 gal. stainless steel; (1) Banbury #3 with 75 HP motor. (2) Kux Rotary Pellet Presses. (4) Sprout-Waldron Horizontal Ribbon Mixers 336 cu. ft. (12,000#) capacity. (1) St. St. Pug Mill 7" diameter x 3'9" long overlapping chambers, jacketed 75#. (4) Mikro Pulverizers #2DH, #2TH, #3TH. (3) Fitzpatrick Stainless Steel Comminuting Machines, Models D, K & F. We Buy Your Surplus Equipment. Perry Equip. Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: 1 Reed-Prentice 10-D-8 Heater: $450.00. Your choice of two. We need one. 1. Factory rebuilt Dec. 54 with cast aluminum heating elements. 2. Original equipment heater with ceramic bands. Reply Box 9003, Modern Plastics.

(*Continued on page* 468)

CHEMISTS

For:	Polymer Chemicals Division of W. R. Grace & Co.
Must Have:	M.S. or Ph.D. Five or ten years in Polymer Chemistry
Location:	N. Y. Metropolitan Area
Submit:	Complete resume
Write:	Industrial Relations Division 7 Hanover Square New York 5, New York

CHEMISTS

Compare!

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FASTEST PRESS OPERATORS *WANT IT!*

COST CONSCIOUS MOLDERS *SPECIFY IT!*

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IT ISN'T SIZE— IT'S Quality THAT COUNTS

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Unbroken Dozen	$18.00

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New Custom Multiframe Hydraulic Presses

Completely new, in design and construction, streamlined Custom Multiframe Hydraulic Presses offer revolutionary improvements over conventional units. These modern presses offer you:

1. Any size platen, any diameter ram —any Capacity.
2. All-steel construction—no castings.
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4. High strength with liberal safety factor.
5. Multiframe construction places load directly on ram—eliminates deflection.
6. Heavy steel frames of press provide extra strength.
7. Five-year guarantee.
8. Reasonably priced.
9. Prompt delivery.

Phone or write for quotation to your exact specifications on hydraulic presses for any purpose.

Custom Machine & Design, Inc.

P.O. Box 1064 Telephone HEmlock 4-9141
200 South Forge St. Akron 9, Ohio

EXCLUSIVE SALES AGENTS—AKRON RUBBER MACHINERY CO., INC.

(*Continued from page 466*)

FOR SALE.
Lewis Injection Molding Machine. New Late 1953. 6-8 oz. model. Excellent Condition. Can be seen in operation. Immediate delivery.
E & W Plastics, Inc.
447 W. Cedar
Akron, Ohio
POrtadge 2-8879

FOR SALE: Hydraulic Presses: R. D. Wood 2500, 8-Opening, 84"x54" Steam Platens. HPM 1200 Ton, 15-Opening Laminating Presses, 100"x120" Platens, Self-Cont. Elmes 1000 Ton Hobbing. M. D. Pump. HPM 750 ton, Down-Acting, 59"x44" Bed, Self-Contained. Farrel 625 Ton, 52"x52" Platens, Self-Contained. Watson-Stillman 600 Ton, Hobbing, M. D. Pump. Farrel 393 Ton, 2-Opening, 48"x48" Steam Platens. Elmes 350 Ton, Down-Acting 30"x36" Bed, Self-Contained. Lake Erie 300 Ton, 30"x30" Platens, Self-Contained, Semi-Automatic. Lake Erie 215 Ton, 36"x36" Platens, Self-Contained, Semi-Automatic. Carey 150 Ton, 21"x16" Platen, Adj. DLO 8"-28" (3). Lake Erie 100 Ton, Down-Acting, 24"x24" Bed, Hi-Speed, Self-Contained. Farquhar 100 Ton, Down-Acting 30"x28" Bed, Self-Contained. Farquhar 100 Ton, Drawing, Down-Acting, 29"x34" Bed, High-Speed, Self-Contained. HPM 100 Ton, Fastraverse, Down-Acting, 30"x30" Bed, Self-Contained. Watson-Stillman 100 Ton, Down-Acting, 22"x20" Bed, Self-Contained. Watson-Stillman 100 Ton, Burroughs 75 ton, HPM 35 Ton Molding Presses. Farquhar 75 Ton Up-Acting 30"x42" Platens. Dake 75 Ton, Die Tryout Press, Practically New. Baldwin-Southwark 50 Ton, Angle Molding Press. Farrel 50 Ton, 12"x12". Loomis 40 Ton, 4-Opening 12"x12" Steam Platens. Francis 40 Ton, 4-Opening, 12"x12" Elec. Ht. Platens. Baker 30 Ton Full Automatic 21"x26". Watson-Stillman and Elmes 30 Ton and 20 Ton Lab Presses. Stokes Model 200D-2, 15 Ton Automatic and Stokes, 300, 200, 150 and 100 Ton Semi-Automatic Molding Presses, All Self-Contained. Injection Machines: De Mattia, Model B, 24 Oz. HPM, Model 350-H-16, 16 Oz. Reed-Prentice, 12 Oz., 1952 machine. HPM 200 H-9, 9 Oz. Impco, 8 Oz. Vertical Model V-F-8, Late Model. Watson-Stillman, 6 Oz. Watson-Stillman, 2 Oz. Van Dorn, Model H-200, 1 Oz. and 2 Oz. Tablet Machines: Stokes S-5, RB-2, RD-4, RDS-3, R and T, Colton #5½, #5, #2-RP and #3-RP Kux 64. Extruders: Royle Nos. 1, 3 and 4; Allen-Williams 8" —All Individual Motor Drive. 3½" Electrically Heated Extruder. Mills: Farrel 18"x50" (4); Farrel 16"x40" (3); Farrel 15"x36" (2)—Available as Mill Lines or as Individual Units. Farrel 20"x22"x72" (2). Birmingham 20"x60", Thropp 20"x 22"x60" (2). Rotary Cutters: Cumberland No. 0, 2 HP M. D. Ball & Jewell 1 HP M. D., Stainless Steel. Ball & Jewell 1 HP M. D., Platen Steel. Ball & Jewell Heavy Duty Ideal, 5HP M. D. Calenders: 13"x 48" with M. D. 9"x48" Rolls Belt Drive. Mixers: Banbury No. 9 200 HP Motor Drive. Banbury No. 3A 150 HP M. D. Banbury No. 3A Body and Base. Miscellaneous: Sturtevant blenders: 1 #2 20,000 lbs. capacity, practically new. 12 #10 13,000 lbs. capacity—never used. Stokes Vacuum Impregnating Equipment. Despatch 3 Drawer and 8 Drawer Pre-heating Ovens. Megatherm 3 KW Pre-heating Ovens. Vulcanizers, Grinders, Pumps, Valves, Platens, Etc. Johnson Machinery Company, 683P Frelinghuysen Avenue, Bigelow 8-2500, Newark 5, New Jersey. What Have You For Sale? What Are You Looking For?

FOR SALE: Ball & Jewell #1½ Granulator. Completely overhauled, 25 HP motor, ball bearing mounted, price $1750 for immediate sale. Reply Box 9048, Modern Plastics.

FOR SALE: Auto-Vac, 30"x50" molding area; completely equipped; operated less than 30 hours; reasonably priced to sell; can be seen in operation. Also, three Cumberland Grinders size 0. Contact The Dover Molded Products Company, Dover, Ohio.

FOR SALE: 8-12-16-22-Oz. Reed Prentice, HPM, W. Stillman Lester Phoenix Injection Molding Machines: 1950 & later. 1400 T. Adamson United Press, 10 openings, 2¾"; 150"x74" platens, 2000# working pressure 250 PSI, new '42. 2500 T. Wood Press, platens 84"x54"; 8 platens, 3" thick; 8 openings 2½" daylight each, 4 posts 15" dia. 5000# 50 T. W. Stillman Transfer Press, new '44, 11" dia. ram 12" stroke, platen 12"x18", top and side rams, horiz. type. 20 T. Elmes Lab Presses new '44, up acting, w/ steam and electric heated platens. Cored for steam & flexible lines. Brand New Phenolic Molding Compounding Plant. Output 1500 to 3000# per hr. for resin & filler to be converted to molding power (phenolic). All new and in original crates. Gorton #9J Duplicator, complete w/ tracer, ser. 17720 cl. Eveready: 805 Housatonic Ave.: Bridgeport, Conn. EDison 4-9471.

SELLING BELOW MARKET PRICES: Heavy Duty W. & P. Jacketed Mixers double arm; 100 gal. and 200 gal.: Lab Banbury Mixer: Falcon latest type Sanitary Ribbon Mixers in Steel or Stainless; Rotary Cutters; Stokes & Colton Tablet Presses; Mikro Pulverizers; Williams Hammer Mills; Sifters; Dust Collectors; Try your First Source for the Best Rebuilts in the industry; your inquiries answered quickly and accurately; we'll trade for or buy your surplus equipment. First Machinery Corp., 209-289 Tenth St., Brooklyn 15, N.Y.

FOR SALE: Injection Presses: 4,8,12,24 oz. Reeds. 2,9,16 oz. HPM. 32 oz. Vertical HPM. 8,12 oz. Lester. 4 oz. Lewis. 3 oz. vertical Munton. 1 & 2 oz. Van Dorn. Extruders: 4½" Oilheated. NRM. 2" steam heated. NRM Saran Extruder & Pipe Setup. Conveyors. Cumberland Granulator No. 1.—Ovens—Compression & Transfer Presses 50 to 600 Ton. Preform presses: Colton 5½ T & 3. Auto-Vac 52"x30" Vac. Form. Mach. 200 T. Hobbing press. All Midwest Locations. List your surplus equip. with me. Justin Zenner, 823 West Waveland Ave., Chicago 13, Ill.

FOR SALE: One HPM—#250-H9 Hydropower Injection Machine with CH-12 HPM Hydro-power dual circuit operating system with (2) 7-R-45X Radial pumps including 20 HP 1200 HPM General purpose sleeve bearing motor. One HPM—#100-H4 Injection Molding Press 4 oz. with one CH-12 HPM Hydro Power Operating System. Both machines are in good operating condition. Reply Box 9042, Modern Plastics.

Machinery and equipment wanted

WANTED TO BUY: 2 Horizontal, jacketed, double arm kneaders, 100-200 gallon capacity, power unloading. Give complete description, price, and inspection location. Reply Box 9004, Modern Plastics.

WANTED: Buy or rent—Clothes sprinkler mould for Canadian manufacturer. Reply Box 9045, Modern Plastics.

Materials for sale

FOR SALE: 8,000 lbs. Virgin Light Green High Impact; 14,000 lbs. Reprocessed Red High Impact; 20,000 lbs. Natural and Colors C-11; 20,000 lbs. Silver Polyethylene and Polystyrene; 15,000 lbs. Transp. Red Methyl Methacrylate Taillight formulation; 15,000 lbs. Light Amber Cellulose Acetate; 20,000 lbs. Regr. Butyrate; 50,000 lbs. Rigid Solid and Mixed Vinyl; 25,000 lbs. Virgin and Repr. Vinyl compound for injection or extrusion. Samples and prices on request.
A. Bamberger Corp.
703 Bedford Ave.
Brooklyn 6, N. Y.
MAin 5-7450

FOR SALE: Approx. 40,000# contaminated regrounds, primarily Polystyrene with Acrylic, Acetate and Butyrate contamination. Reply Box 9044, Modern Plastics.

FOR SALE: Unworked Diatomaceous Earth Deposit, Center Barnstead, N.H. Analyzed 17 years ago by Univ. of N.H. —depth 7 ft. to 30 ft. over distance of 500 ft. Reply Box 9040, Modern Plastics.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
A. Bamberger Corporation
703 Bedford Ave., Brooklyn 6, N. Y.
MAin 5-7450

PLASTIC SCRAP WANTED: All types and grades, any quantity. Write or telephone, Success Plastics Recovery Works, Inc., Post Office Box 506, Indianapolis 6, Ind. Phone Liberty 6-2919.

WANTED: Plexiglass and Lucite scrap, salvage and cut-offs, any quantity. Turn your surplus sheet stock into cash. Ask for our quotation. Duke Plastics Corp., 584 Broadway, B'klyn 6, N. Y. Evergreen 8-5520.

SCRAP WANTED.
Acetate, Butyrate, Polystyrene, Acrylic, any quantity. Also list your surplus inventory of Virgin molding material with us for sale at highest prices.
Claude P. Bamberger, Inc.
1 Mount Vernon St.
Ridgefield Park, N. J.

PLASTIC SCRAP: Polystyrene, Hi Impact Polystyrene, Polyethylene and Acetate. Top Prices Paid. Plastic Moulding Powders, Inc., 2004 McDonald Ave., B'klyn 23, N. Y. ES 5-7943.

WANTED.
Virgin Molding Powders. Turn Your Surplus Inventory Into Cash.
Reply Box 9038, Modern Plastics.

WANTED: Plastic Scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 601 West 26th Street, New York 1, N. Y.

Molds for sale

FOR SALE: Complete line of Houseware Molds, Comb Molds, also some novelty and specialty items. No reasonable offer refused. Send for list. Reply Box 9037, Modern Plastics.

(*Continued on page 470*)

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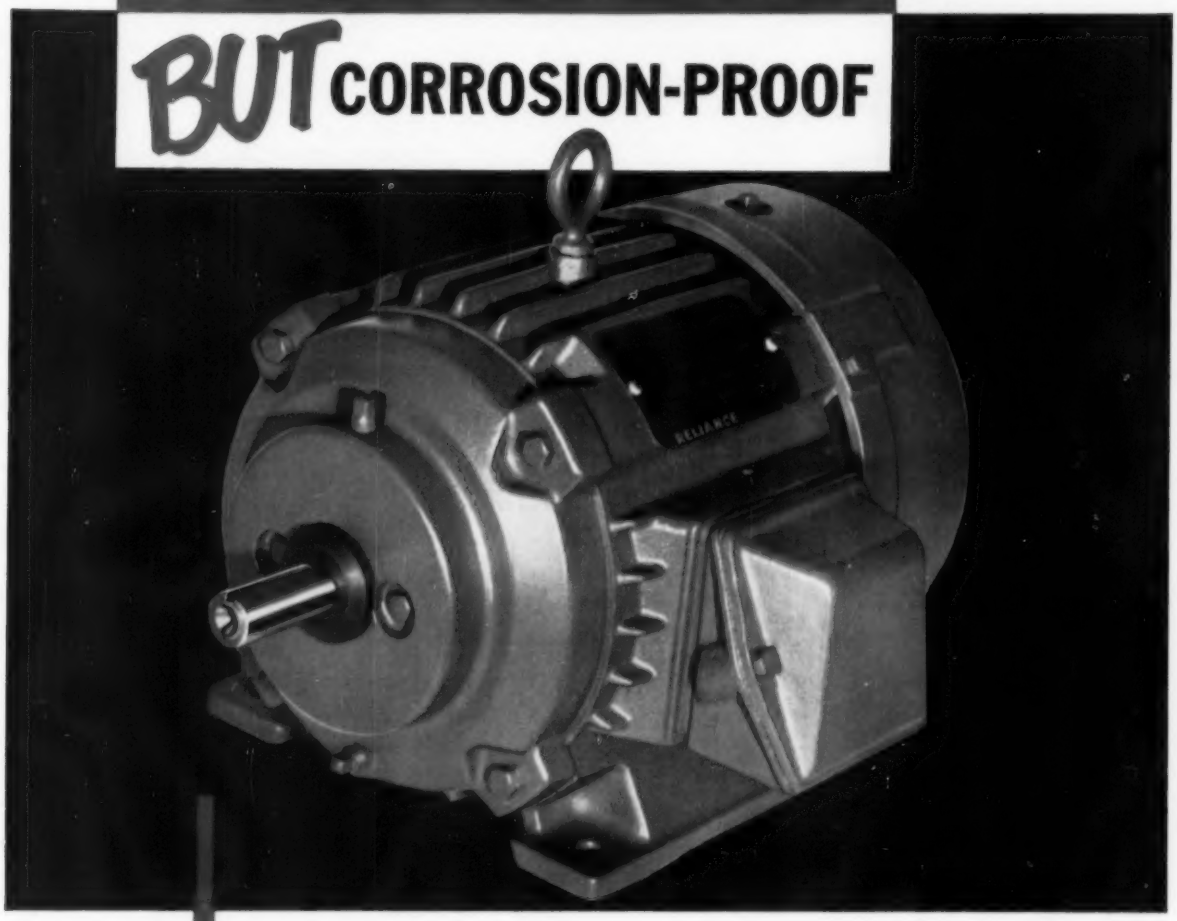

Corrosion resistance is not enough to stop acids or alkalies from chewing up a motor in a hurry. That is why the wise engineer selects Reliance Corrosion-Proof Motors for corrosive service.

These motors are built to withstand the onslaught of destructive chemicals for years. Housings are made of virtually indestructible cast iron. Exterior contours are designed to slough off liquids—no nooks and crannies to retain corrosive elements. Enclosures are sealed to prevent any leakage . . . Metermatic lubrication systems provide complete protection against burned out bearings and contaminated lubricants.

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Sales Offices and Distributors in Principal Cities

(Continued from page 468)

Help wanted

HELP WANTED: New PVC plant in the New York area requires: Superintendent—Must have supervisory or engineering experience in vinyl polymerization. Chemist—Must have extensive development and control experience in vinyl polymerization. These are permanent positions of responsible supervision. Please reply with complete resume of experience and education to Box 9018, Modern Plastics.

POLYESTER TECHNICAL SERVICE.
Our growing position in resins for the reinforced plastics industry has created an immediate opening for a plastics engineer for laboratory and field work on customer problems. Sound technical know-how of the materials, equipment, and techniques involved is a particular requirement for this opportunity in an expanding situation. Please submit detailed resume to:
Hooker Electrochemical Company,
Industrial Relations Department,
Niagara Falls, New York.

NEW PRODUCTS MANAGER: For the man who is thoroughly acquainted with all sales possibilities of Vinyl Sheetings and fabrics, we offer the chance of a lifetime. For our new calender, we are creating a new position of Products Development. Only the man with drive and initiative can succeed in this new opening. If you are thoroughly convinced that you have the knowledge and creative ability to produce new products for this field, let us know about you. All replies Strictly Confidential—Only applicants submitting complete resume will be considered. Send applications to: Mr. Louis Rudd, Rudd Plastic Fabrics Corporation, 620-62nd Street, Brooklyn 20, New York.

VINYL CHEMIST.
Manufacturer calendered film and vinyl sheeting requires experienced chemical engineer or chemist. All replies confidential.
Reply Box 9028, Modern Plastics.

COLOR MATCHER: Thoroughly experienced plastic printing inks for gravure printing. Permanent position. Excellent salary. Write fully. Reply Box 9043, Modern Plastics.

THERMOPLASTIC ENGINEER.
Must be well qualified in die design with injection molding. Graduate M E preferred but not essential. Location Atlanta, Georgia. All replies confidential. Interview may be arranged at our expense. Submit photograph, education, experience, and salary wanted to:
Personnel Director, Scripto, Inc.,
P. O. Box 4847
Atlanta, Georgia.

VINYL COMPOUNDING: Young plastic chemist or engineer wanted for development of vinyl extrusion and molding compounds and production control, Metropolitan New Jersey. Will also consider part time. State experience, salary desired. Replies will be held in strictest confidence. Reply Box 9020, Modern Plastics.

WANTED: Chief Engineer for Medium Compression and Transfer Molder located in Western Pennsylvania. This is an excellent opportunity for the right man to join a young progressive company. Salary open. Reply Box 9032, Modern Plastics.

FLOOR TILE CHEMIST.
Experienced manufacture vinyl tile. Location, Midwest. Liberal insurance and pension plan.
Reply Box 9029, Modern Plastics.

PLASTICS EXTRUSION OPERATOR & Ass't Extrusion Foreman: Wanted by progressive New York City firm. Pleasant working conditions, chance for advancement unlimited by "seniority" and other restrictions. Excellent opportunity for right man—applications treated with strictest confidence. Write, giving full details to: President, Box 9031, Modern Plastics.

VINYL COLOR MATCHER.
Man experienced in color matching and production color control in film and sheeting.
Reply Box 9030, Modern Plastics.

PLASTIC SALESMAN WANTED by Chicago area Custom Injection Molder. We are in the process of expanding and have a newly created position for the right man with proven background of accomplishment in Sales. Opportunity to become Sales Manager with executive capacity. Salary plus commission. Reply Box 9025, Modern Plastics.

SHOP SUPT. WANTED.
Los Angeles plant needs highly experienced man for vacuum and deep draw operations on Plexiglas, Dow and Royalite sheets. Must be thoroughly familiar with all phases of tooling. Must have mechanical background. Applications will be treated confidentially. Reply Box 9041, Modern Plastics.

HELP WANTED: Mechanical Engineer: Small, well established manufacturing company in bearing specialty field adding a high quality injection molded division. Production and equipment engineering experience necessary and mold design experience helpful. Reply Box 9006, Modern Plastics.

CHEMICAL ENGINEER.
Outstanding opening with energetic, progressive organization in Northern New Jersey for a man with 2-5 years experience in application research in field of processing, compounding and formulating of polyvinyl chloride. Experience in calendered plastics, either film or sheeting preferred. Familiarity with pilot plant and manufacturing operations essential. Write with full particulars including salary required.
Reply Box 9014, Modern Plastics

VINYL CHEMIST: Experience in plastisol compounding is required. Product development and vinyl foam experience desirable but not essential. A good opportunity for the right man. Salary commensurate with ability. Contact: Personnel Manager, The Sun Rubber Company, Barberton, Ohio.

ADMINISTRATIVE EXECUTIVE.
For Custom Fiber Glass Molder: Midwest molder of reinforced plastics seeks experienced executive with fundamental knowledge of matched metal molding with both preform and premix materials. Previous training and experience must indicate thorough knowledge of the industry. Age 35 to 50. Position offers unusual opportunity for the right man. All replies to be held in strict confidence. Reply Box 9011, Modern Plastics.

OPPORTUNITY OCCURS for a well qualified sales or chemical engineer now selling to plastic molders and extruders to take on additional line of Nylon molding compounds. Reply Box 9036, Modern Plastics.

CHEMISTS AND CHEMICAL ENGRS.
For product development in plastics field. Outstanding opportunity to join recently formed Product Development Department of the Atlas Powder Company, located in Wilmington, Delaware. 5-10 years experience in polymers and their application uses required. All responses held confidential. Direct all replies, marked personal to,
R. L. Herrman
Atlas Powder Company
Wilmington, Delaware

PLASTIC ENGINEER: Mechanical or Chemical Engineer with Compression and Injection Molding experience, who has the ability to design new molds and molding techniques. Must be capable in doing research and development work. This job requires technical ability and the determination to carry each project through to its completion. Excellent opportunity for a capable man to join a progressive company molding its own products. Midwest location. Write giving full particulars, including salary requirements, in first letter. Reply Box 9007, Modern Plastics.

OUTSTANDING OPPORTUNITY.
We are a strong young company living in a suburban community of sunny southern California. We have the imagination and financial stability to offer an outstanding future to the right man and his family. We would like a chief chemist, preferably with a Ph.D. degree, between 30 and 45 years of age who could start and direct a research and development lab for our company. He should have a solid background in plastics. His chief product at the moment would be polyurethanes. It is essential that he be well adjusted in temperament and have a pleasing appearance. The starting salary would be $12,000 per year with vast advancement potential depending upon merit. All replies will be held in strictest confidence.
Reply Box 9034, Modern Plastics.

INDUSTRIAL MARKET RESEARCH: Desire man experienced in sales, technical service, product development, or market research in plastics. Excellent opportunity with growing firm. Salary open. Reply Box 9012, Modern Plastics.

SALESMAN WANTED: For small growing Company in Metropolitan New York area. Must have some knowledge of plastic industry. Send resume. Information kept confidential. Reply Box 9022, Modern Plastics.

PHYSICIST.
BS degree in Physics and up to 3 years experience in plastics. For physical testing and evaluation of plastics. To apply fundamental principles in solving problems related to the accurate measurement of physical properties of plastics and to assist in establishment of controls and standards. This is a permanent position in Celanese's expanding research laboratories in Summit, New Jersey, a pleasant residential suburb within 30 miles of New York City. Please send resume including salary desired to J. A. Berg.
Celanese Corp. of America
Morris Court
Summit, N. J.

INJECTION MOLDING FOREMAN: Modern Plant, 7 machines, Brooklyn. Good opportunity for thoroughly experienced foreman. Steady work. Also openings for assistant foremen. Reply Box 9046, Modern Plastics.

(Continued on page 472)

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Stabilizer Mark M or Mark M—Mark PL combination

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H. M. Royal, Inc., 4814 Loma Vista Ave., Los Angeles
Phillipp Bros. Chemicals, Inc., 176 Federal St., Boston
H. L. Blachford, Ltd., 977 Aqueduct St., Montreal

(*Continued from page 470*)

TECHNICAL SERVICE REPS. and Technical Salesmen: Plastics and Industrial Chemicals. Your opportunities are greater with a "Growth Company." Spencer is America's Growing Name in Chemicals. If you have a technical background or experience in thermoplastics processing or sales, we have several very attractive positions to offer. Please outline your education, experience, and initial salary requirement. Your inquiry will receive immediate attention and will be held strictly confidential. Write: Technical Service Section, Industrial & Plastic Products, Spencer Chemical Company, Dwight Building, Kansas City, Missouri.

PLASTIC SALES ENGINEER: We are seeking a well qualified man experienced in plastics extrusion for attractive Market Development position. Kindly give your education, experience, and expected salary in complete resume. All replies will receive careful attention and will be held confidential. Write: 103 Personnel Department, Chemical Division, Koppers Company, Pittsburgh 19, Pa.

CHEMIST-DIRECTOR of Research and Development thoroughly experienced in melamine surfaced high pressure decorative laminates to take full charge of laboratory, trouble shooting and development. Excellent salary, bonus, future with expanding Eastern manufacturer of laminates. Send resume. Reply Box 9013, Modern Plastics.

Situations wanted

EXECUTIVE: 25 years experience in injection, extrusion and compression molding—seeks administrative position in plant of medium size. Also thoroughly qualified in sales, production or general management. Partnership or part ownership desired. Location preference in Middle Atlantic or New England States. Reply Box 9039, Modern Plastics.

REINFORCED PLASTICS ENGINEER: Process and product development engineer with 8 years experience in reinforced plastics fabrication which includes press molding, bag molding, hand layup, mat production and laminating. Have managed all phases of production. Desire a challenging position with advancement opportunities. B.S.M.E. of M.I.T. Married. Presently employed. Willing to relocate. Reply Box 9010, Modern Plastics.

PRODUCTION MANAGER—SUPT.: Ten years of diversified experience in fabricating of Laminated Phenolics and Vulcanized Fibre. Proven administrative ability. Can take full charge of Management, Buying, Sales, Production and Labor Relations. Desires association with an established firm or a firm with potential growth in same or allied field. Willing to relocate. Reply Box 9016, Modern Plastics.

SALES ENGINEER: Custom Injection Molding. Desires position with efficient, progressive molder. Young, aggressive, 10 years uninterrupted experience in the field. Substantial following among industrial and consumer accounts. Creative sales personality and sales promoter. Thorough knowledge all production problems. Plant to be located near Greater New York area. Salary plus commission or drawing against commission. Reply Box 9015, Modern Plastics.

THERMO-SETTING EXPERIENCE: 18 years—design, production, sales. Now general manager plastics division old company. Set up plastics operation, provided know how, secured suitable equipment, oversaw proper operation, ran sales producing good custom business compression and transfer molding. Previously operated own thermo-setting plant proprietary and custom molded parts. Age—46, married. Holds B.S. degr. Chem. Engr. Reply Box 9049, Modern Plastics.

PLASTICS TOOL ENGINEER: Presently employed as Chief Tool Engineer with large molding firm seeks opportunity for advancement with progressive firm. Excellent background with 16 years experience in mold design, mold construction, product design and mold procurement. Solid supervisory background, married, college degree. Reply Box 9035, Modern Plastics.

EXTRUSION ENGINEER: 15 years experience in all phases of thermoplastic extrusions. Background includes die and machine design and construction, process development and execution, production control and supervision—new plant installation and maintenance. Reply Box 9017, Modern Plastics.

Sales agents wanted

MANUFACTURERS REPRESENTATIVE: Wanted by Chicago area Custom Injection Molder. Modern plant with tool room. Molding capacity up to 16 oz. with facilities for finishing molded parts. Commission basis. Most territories open. Reply Box 9024, Modern Plastics.

WANTED.
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SALES AGENTS WANTED: Long established custom injection molding company in New York City seeks commissioned representatives with industrial or other contacts. Familiarity with injection molding process desirable. Most territories open. Reply Box 9027, Modern Plastics.

SALES REPRESENTATIVE: Cleveland custom molder of fiber glass reinforced plastics and vacuum former of thermoplastic sheet seeks sales representative for various territories including Chicago, Detroit, and other eastern seaboard areas. Reply to P. O. Box 857, Cleveland 22, Ohio giving full particulars.

Miscellaneous

MOULDS WANTED: Houseware moulds, must be in good condition. Reply Box 9002, Modern Plastics.

CANADA: Housewares Molds and equipment with market already established. Other established businesses in all phases of the plastics industry in Canada. Barnett J. Danson & Associates, 1912A Avenue Road, Toronto 12.

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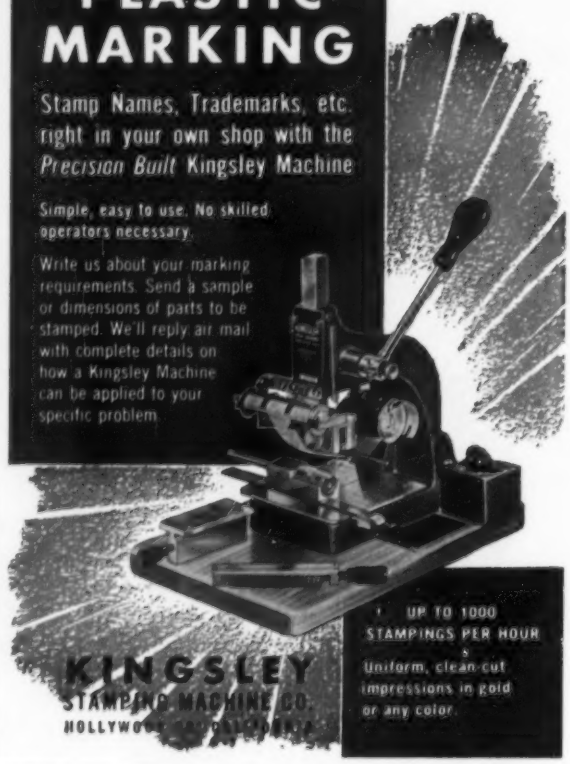

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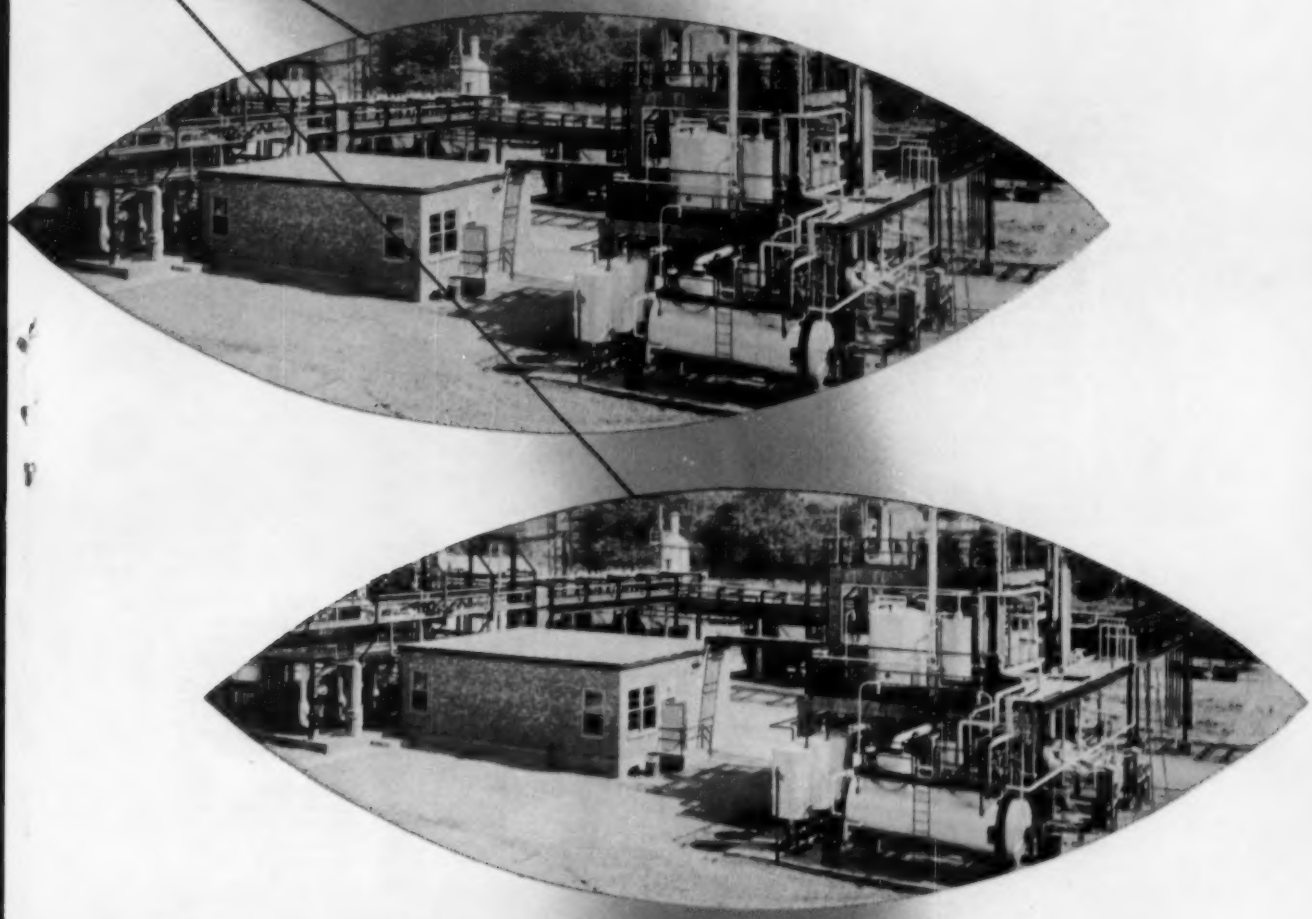

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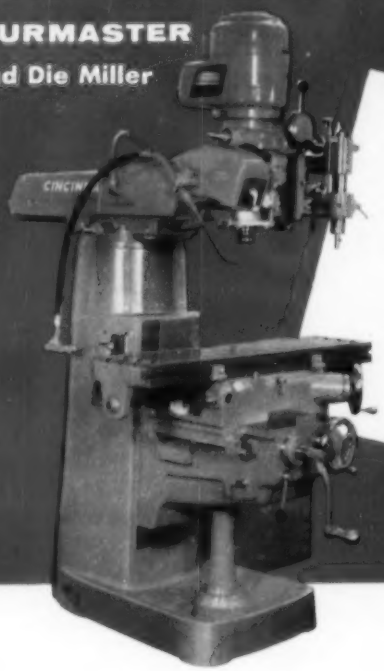

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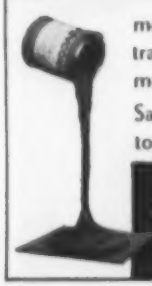

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*Patents pending by
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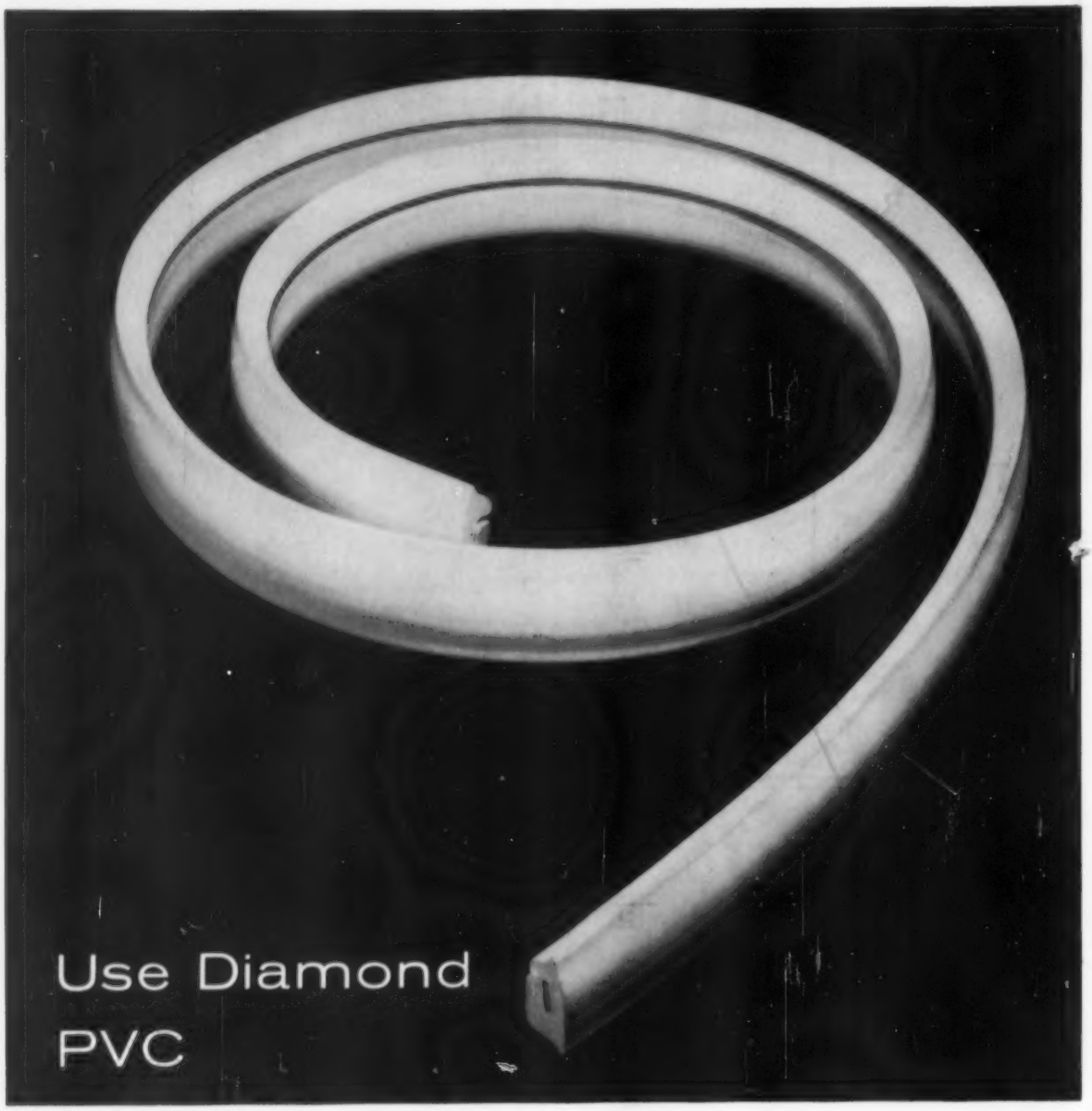

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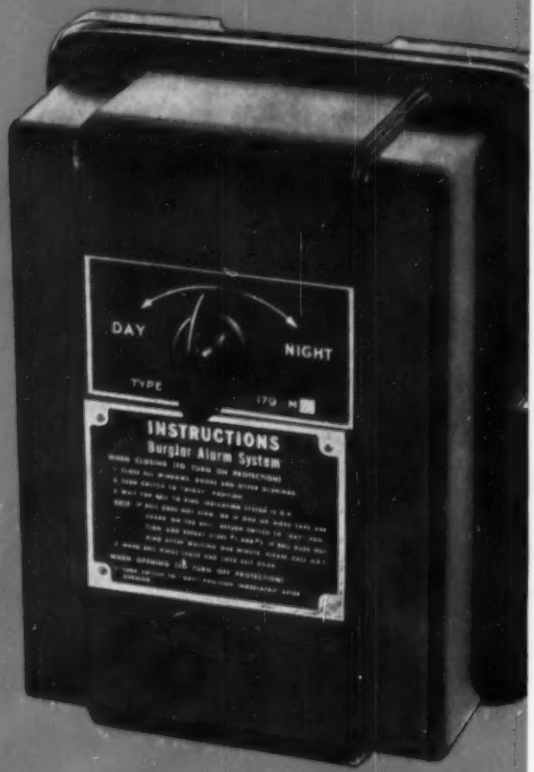

That's what the American District Telegraph Company, New York City, reports! As Chief Engineer M. H. A. Lindsay says, "The covers for our burglar alarm control units must be rugged! These units are usually located on store walls where things get knocked against them. A lot of our covers used to be broken even though made of 'impact-grade' plastics. But now, since we switched to a General Electric shock-resistant *rubber*-phenolic, our field reports read: 'Breakage is nil'."

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